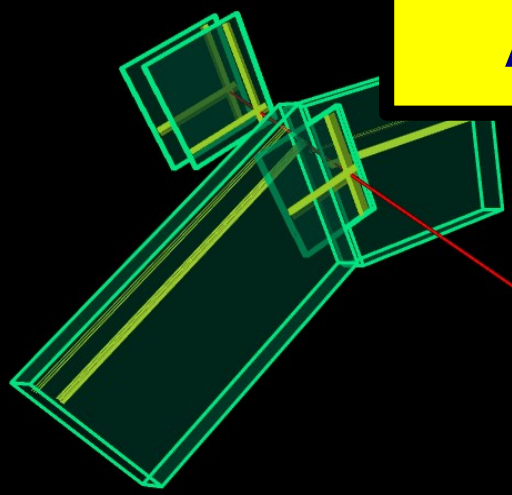
ATLAS Results and Prospects



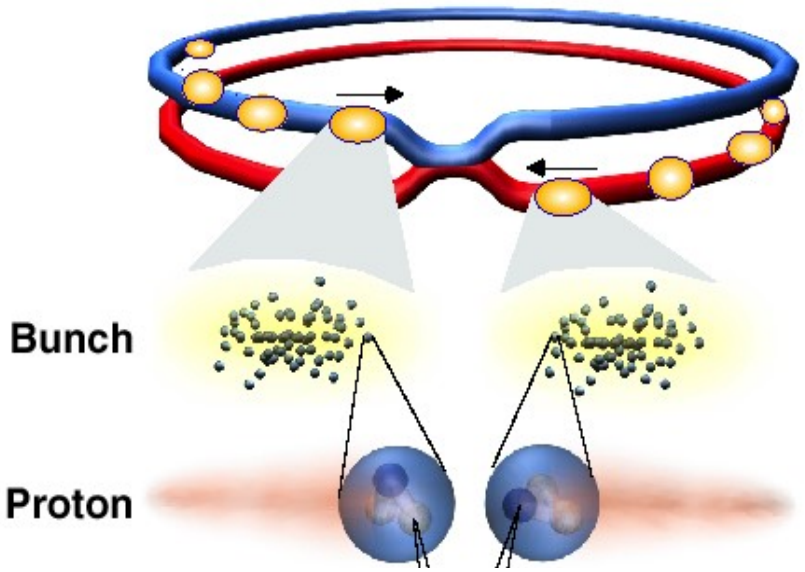
LHC Symposium
PSROC Meeting,
Taipei, Taiwan
26 January 2011

Dave Charlton
University of Birmingham

LHC Status
ATLAS Status
Physics Results
Prospects


Lake Geneva
LHC tunnel – 27km circumference
(50-100m underground)
CMS
The LHC
LHCb
ATLAS
ALICE
CERN main site

LHC Parameters



$$\mathcal{L} \propto \frac{N_1 N_2 n_b}{\sigma^2}$$

Key parameters:

N_i = bunch intensity

n_b = number of bunches

σ = colliding beam size

Design	Achieved in 2010
$\sqrt{s}$ = 14 TeV	7 TeV
N_i = 1.1 x 10^{11} p/bunch	1.2 x 10^{11} p/bunch
n_b = 2808	up to 368 with collisions
Δt = 25 ns	150 ns (75ns for tests)
L = 10^{34} cm^{-2}s^{-1}	2.1 x 10^{32} cm^{-2}s^{-1} (2010 goal: 10^{32})

30 March 2010: Preparing to collide 3.5 TeV beams...

OP Vistars - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://op-webtools.web.cern.ch/op-webtools/vistar/vistars.php?usr=LHC1

Most Visited | Scientific Linux CERN | CERN IT Departme... | CERN Home Page | Linux distributions

CERN - AB - OP eLogbook - Vi... | CERN - AB - OP eLogbook - Vi... | CERN - AB - OP eLogbook - Vi... | CERN - AB - OP eLogbook - Vi... | OP Vistars

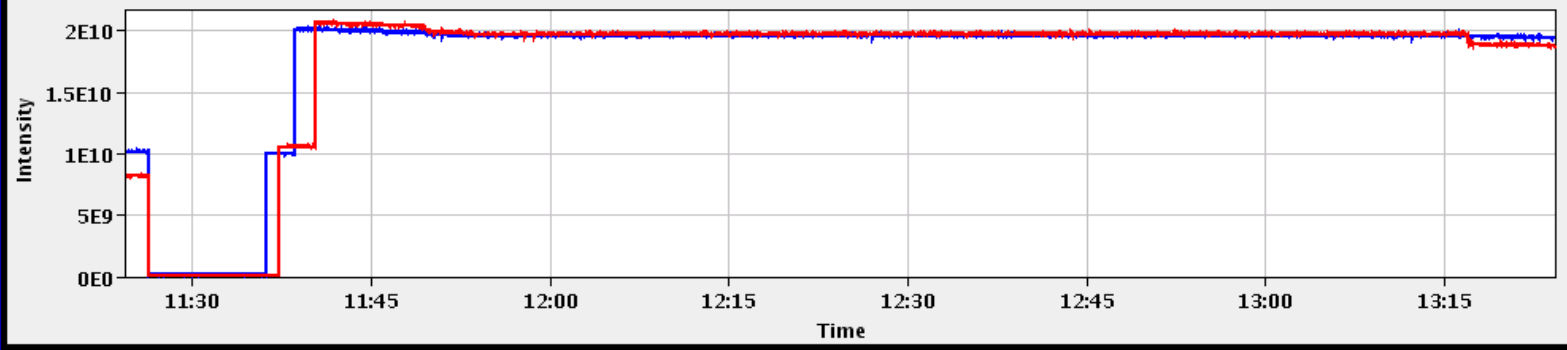
LHC1 — OP Vistars

LHC Page1 | Fill: 1005 | E: 3500 GeV | 30-03-2010 13:24:16

PROTON PHYSICS: STABLE BEAMS

Energy:	3500 GeV	I(B1):	1.88e+10	I(B2):	1.68e+10

FBCT Intensity — Updated: 13:24:16



Comments 30-03-2010 13:22:57 :

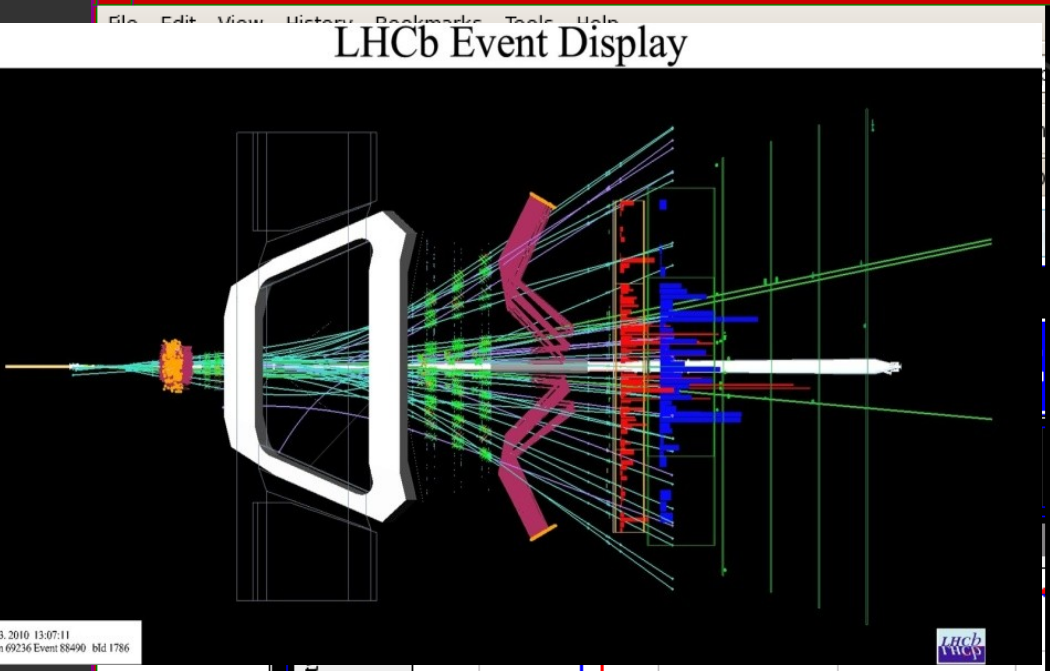
Stable beams!

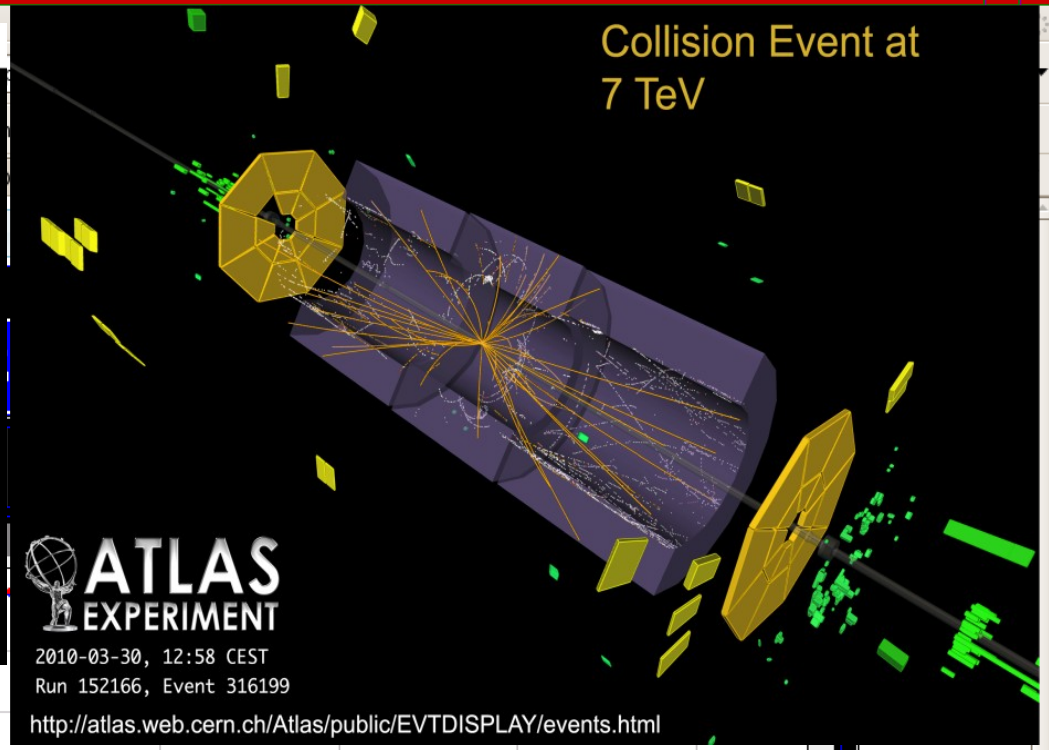
BIS status and SMP flags	B1	B2
Link Status of Beam Permits	true	true
Global Beam Permit	true	true
Setup Beam	true	true
Beam Presence	true	true
Moveable Devices Allowed In	true	true
Stable Beams	true	true

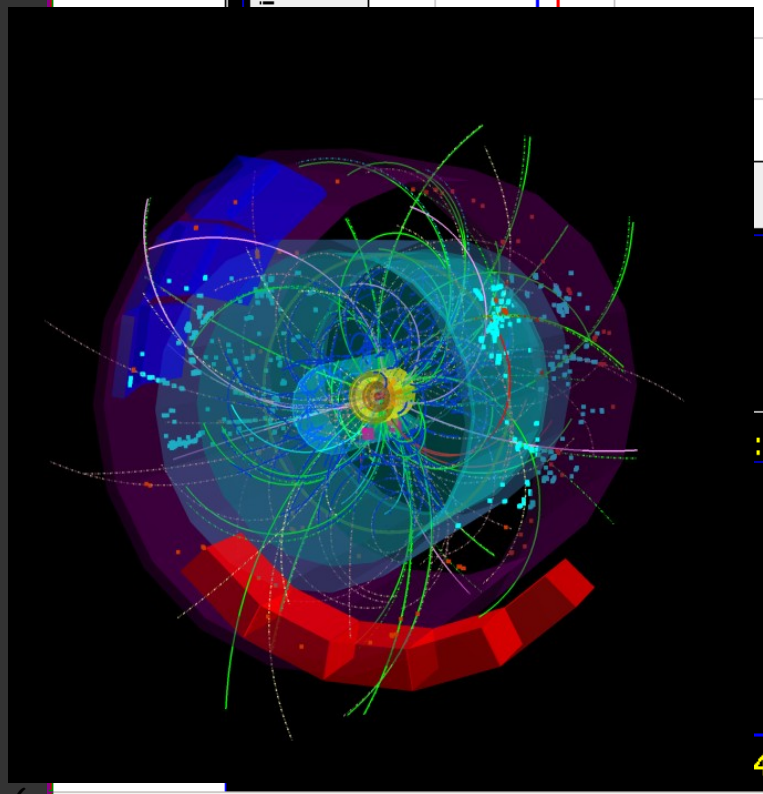
LHC Operation in CCC : 77600, 70480

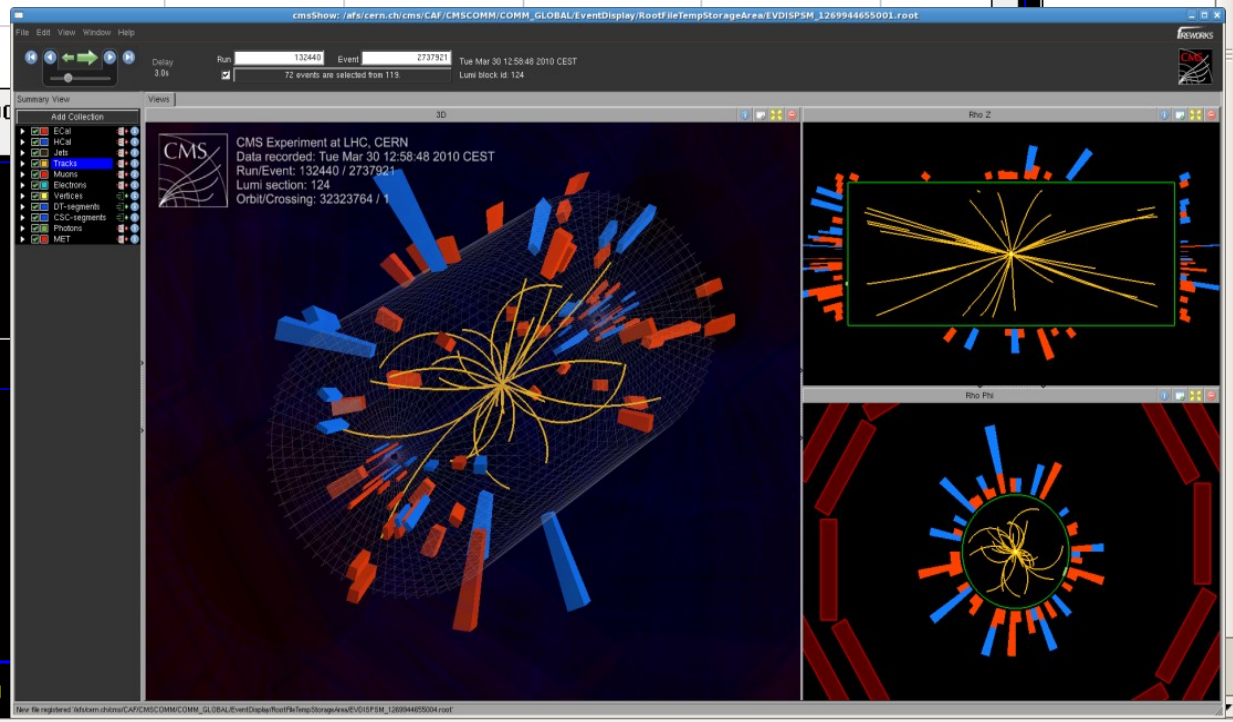
PM Status B1: ENABLED | PM Status B2: ENABLED

Done


LHCb Event Display


Collision Event at
7 TeV
ATLAS
EXPERIMENT
2010-03-30, 12:58 CEST
Run 152166, Event 316199
http://atlas.web.cern.ch/Atlas/public/EVTDISPLAY/events.html

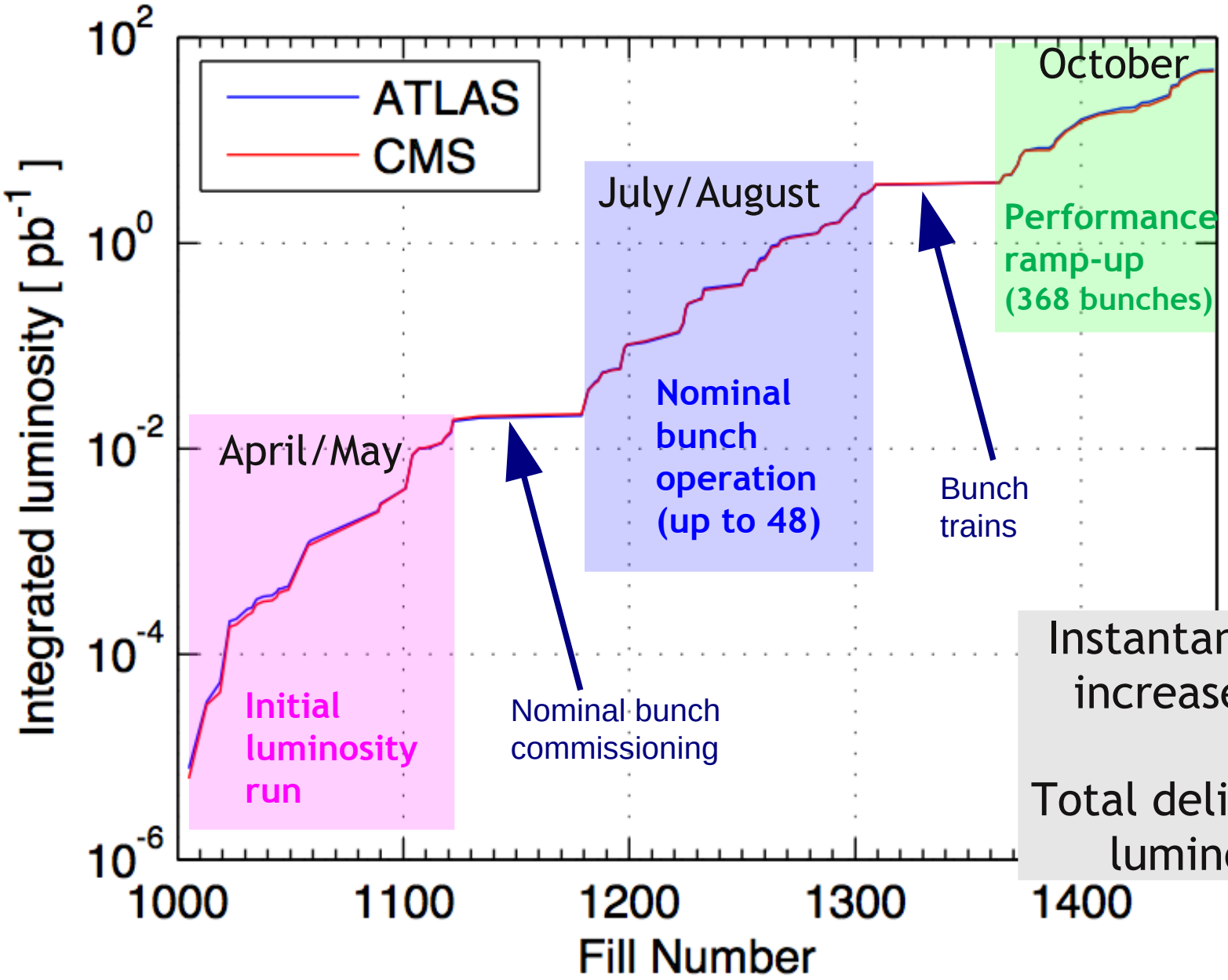

480


CMS
CMS Experiment at LHC, CERN
Data recorded: Tue Mar 30 12:58:48 2010 CEST
Run/Event: 132440 / 2737921
Lumi section: 124

Done


OP Vistars - Mozilla Firefox
LHCb Event Display
Collision Event at
7 TeV
CERN
480
Done

Luminosity in 2010



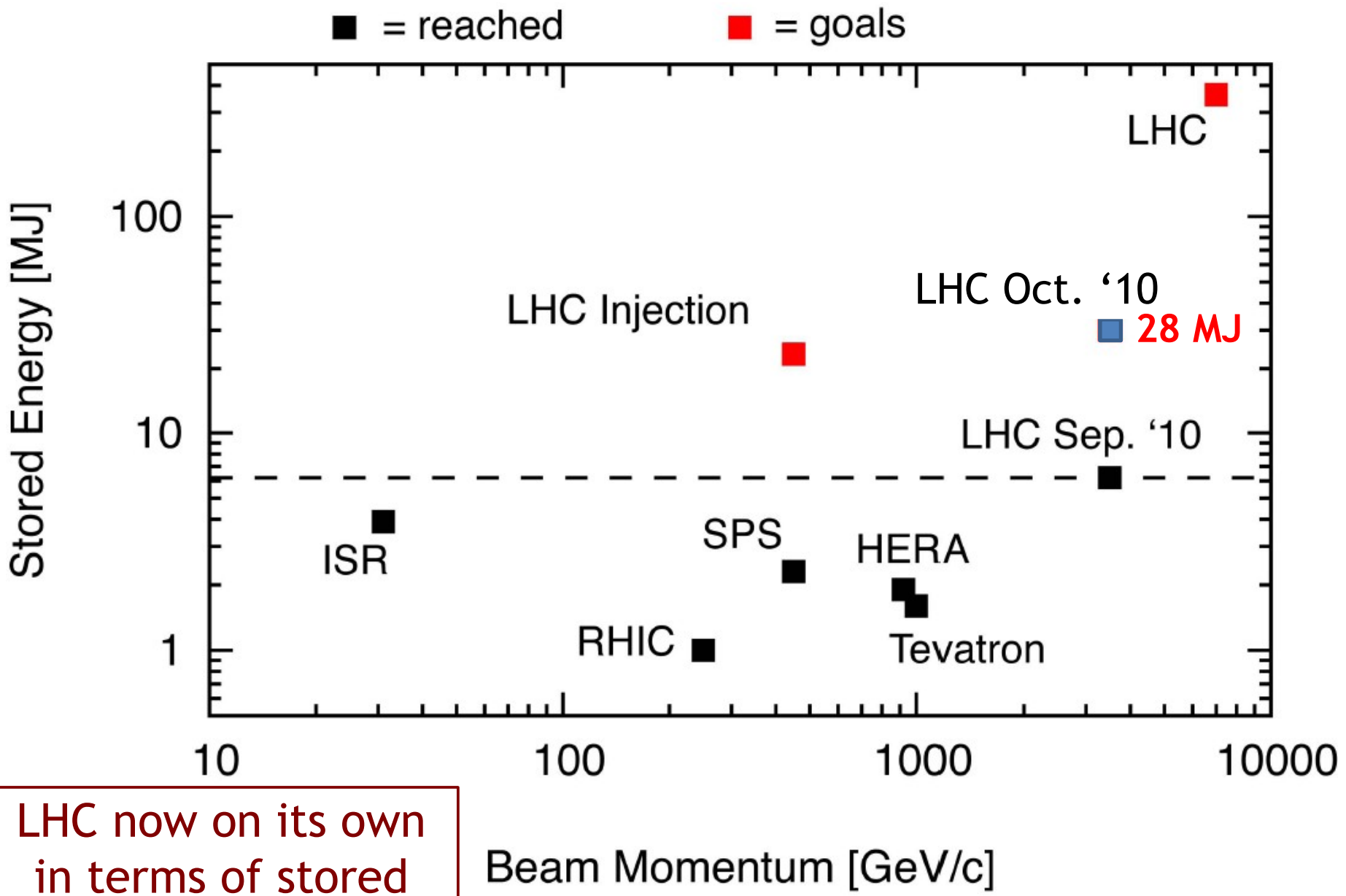
Luminosity determined using van der Meer scans

Error ±11% (dominated by beam current error)

Instantaneous luminosity increased x10^{5} in 2010

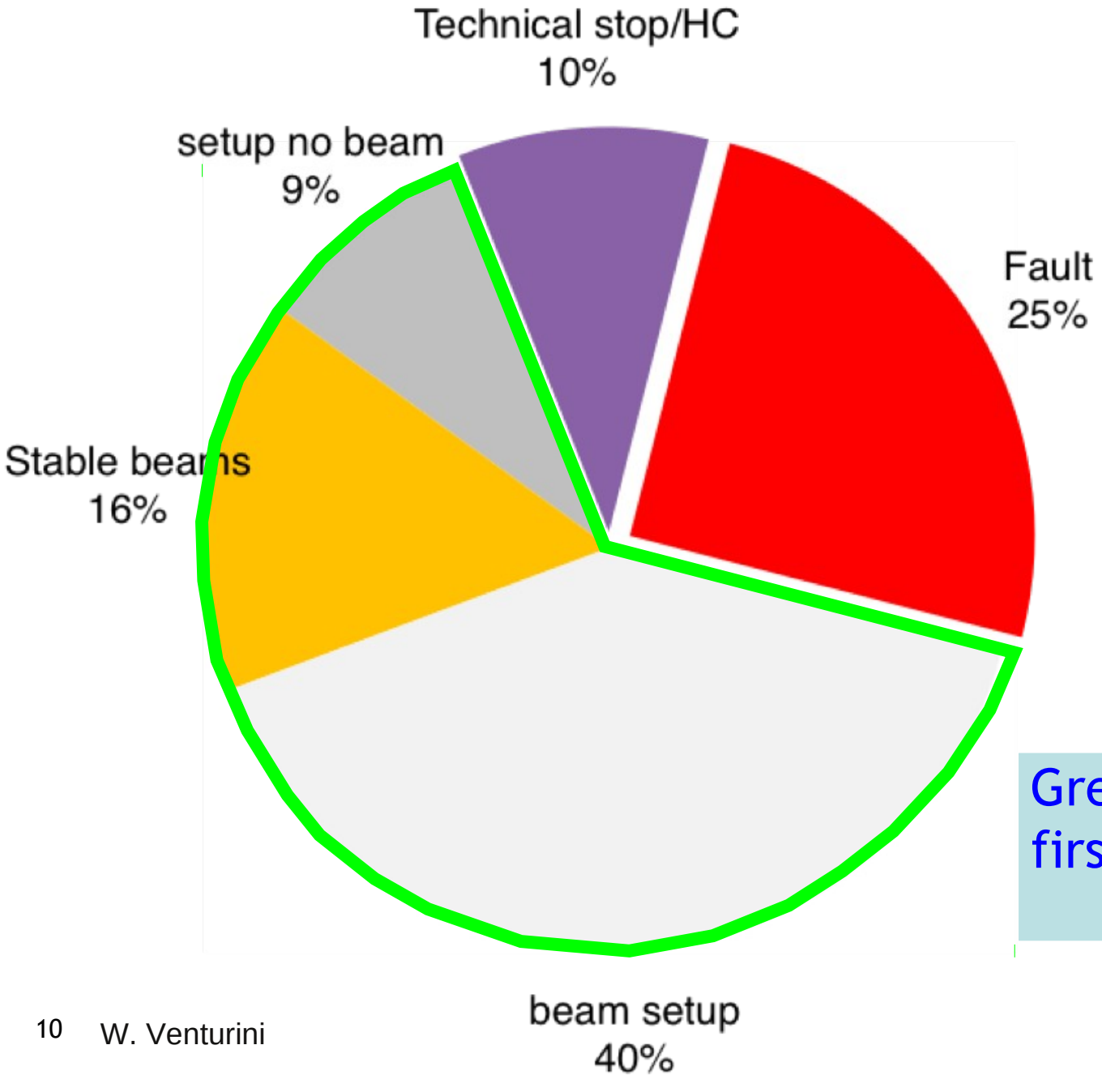
Total delivered integrated luminosity ~48 pb^{-1}

Stored Energy in the Beams



LHC now on its own in terms of stored energy in the beams

LHC Operating Efficiency



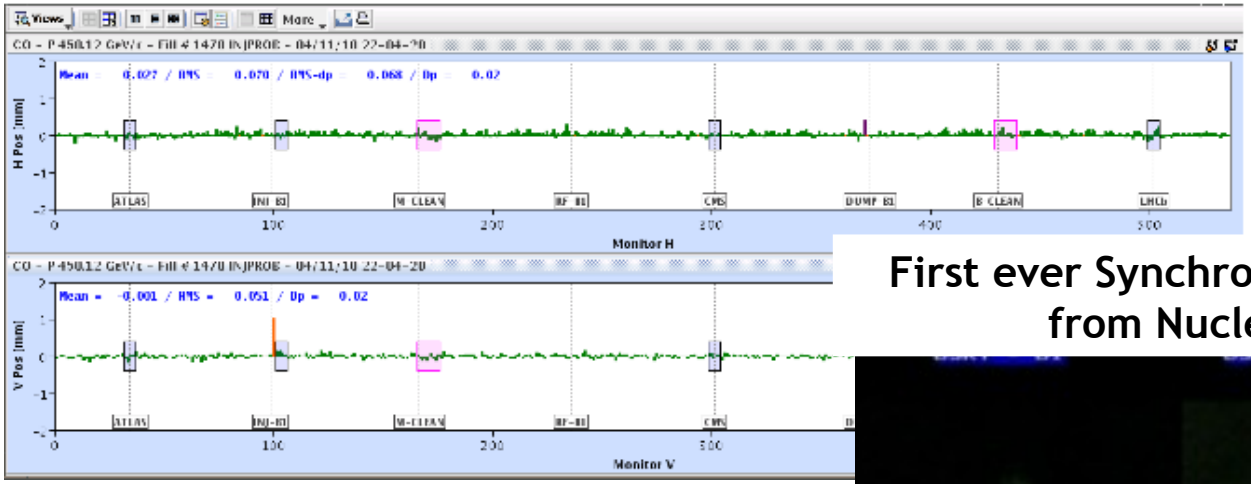
65% availability!

Great achievement for the first year of operation of a new collider

Heavy Ion Operation

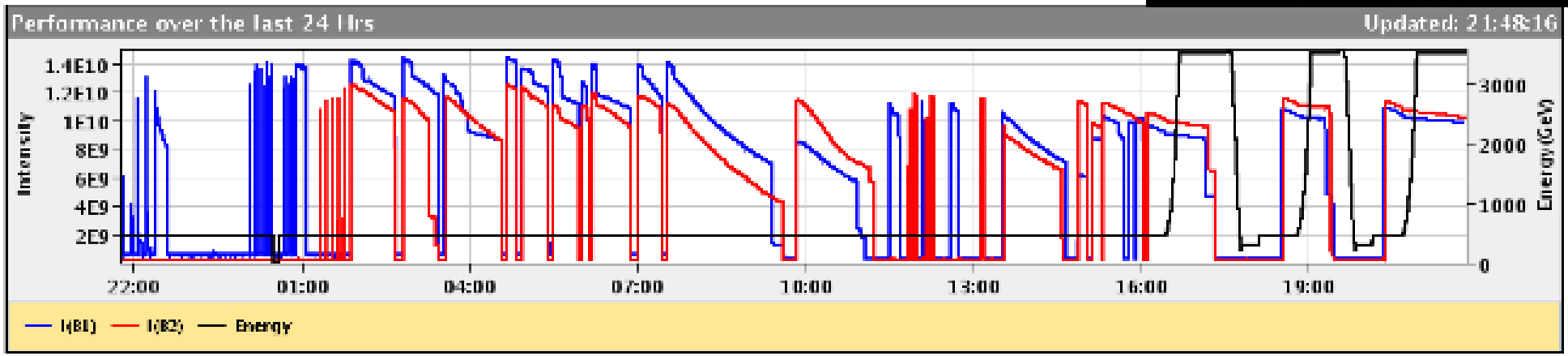
Nov 4th: switched from protons to $^{208}Pb^{82+}$

Circulating beam quickly established: identical magnetic machine.



First ever Synchrotron light from Nuclei

First 24 hours

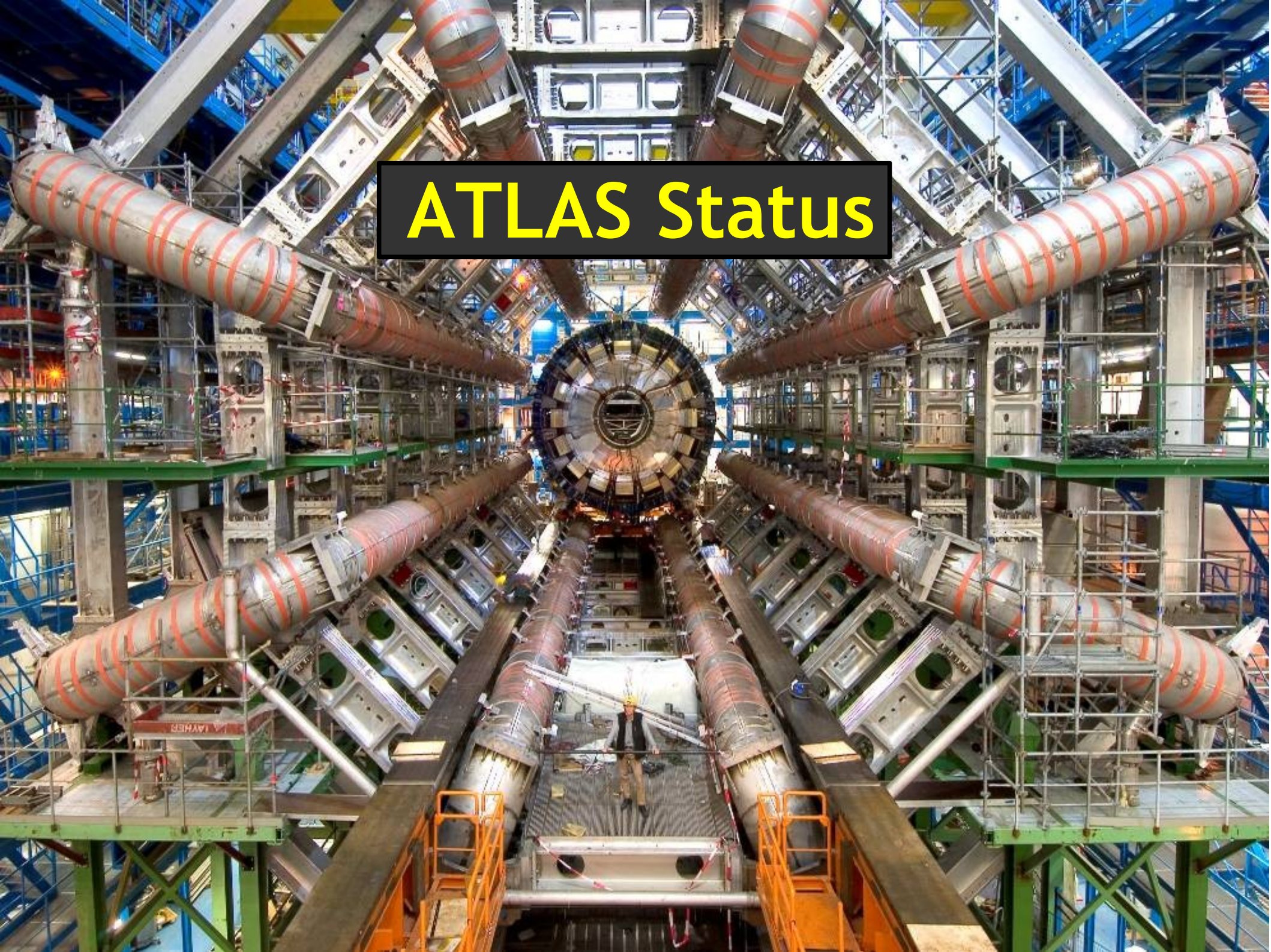


Beam1 : injection and capture

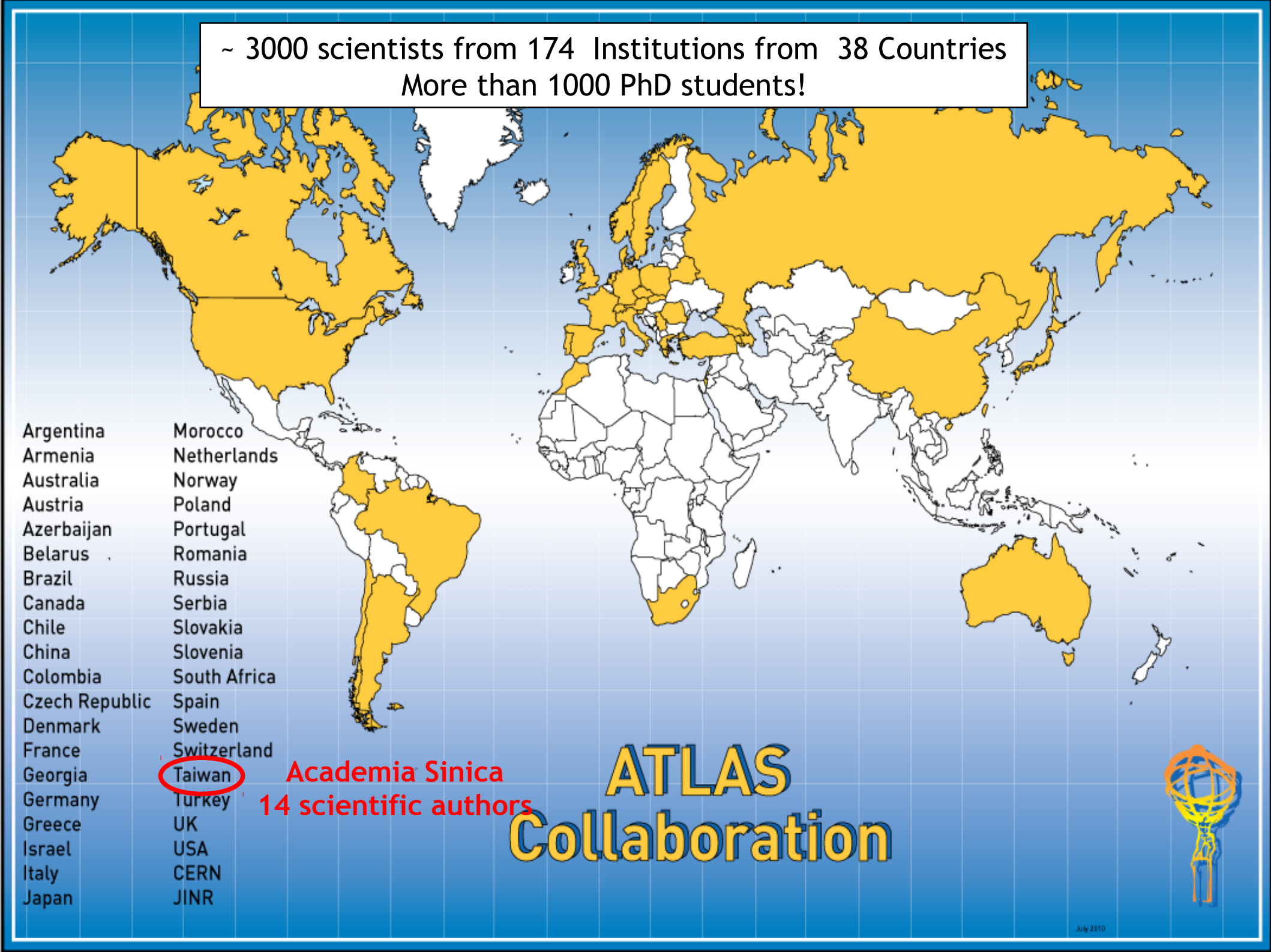
Beam2: injection and capture

Optics Checks, Beam Instrumentation & Collimation

First ramp, collimation at high energy and squeeze


ATLAS Status

~ 3000 scientists from 174 Institutions from 38 Countries
More than 1000 PhD students!



Argentina
Armenia
Australia
Austria
Azerbaijan
Belarus
Brazil
Canada
Chile
China
Colombia
Czech Republic
Denmark
France
Georgia
Germany
Greece
Israel
Italy
Japan
Morocco
Netherlands
Norway
Poland
Portugal
Romania
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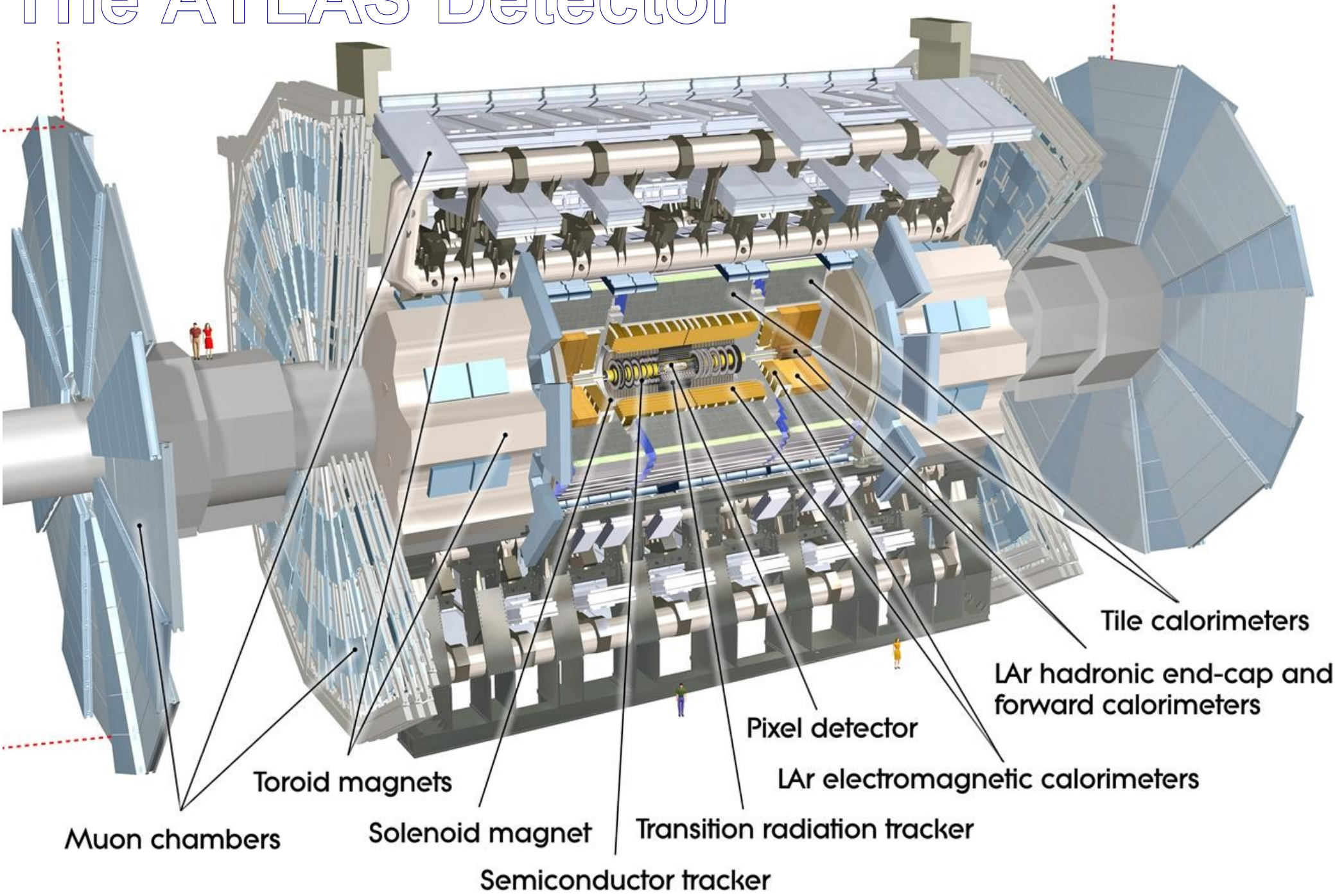
Serbia
Slovakia
Slovenia
South Africa
Spain
Sweden
Switzerland
Taiwan
Turkey
UK
USA
CERN
JINR

Academia Sinica
14 scientific authors

ATLAS
Collaboration

July 2010

The ATLAS Detector

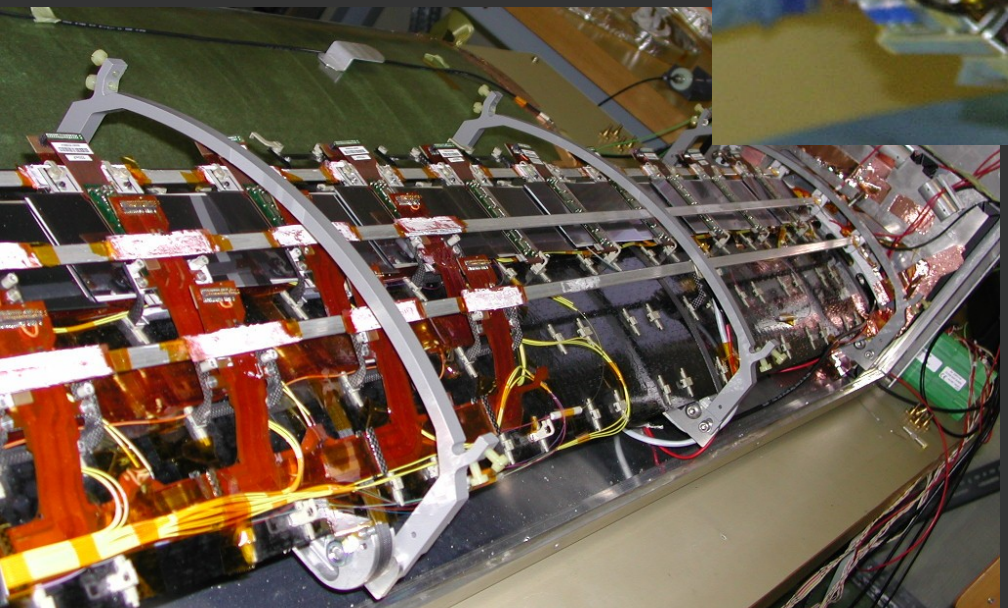


Solenoid: 2T Toroids: ∫Bdl=1-7.5 Tm Tracking |η|<2.5 Calorimetry |η|<4.9

Optical Links

Optical readout links for pixel+SCT, and LAr+Tile calorimeter provided by Academia Sinica ATLAS team

→ Suen Hou talk



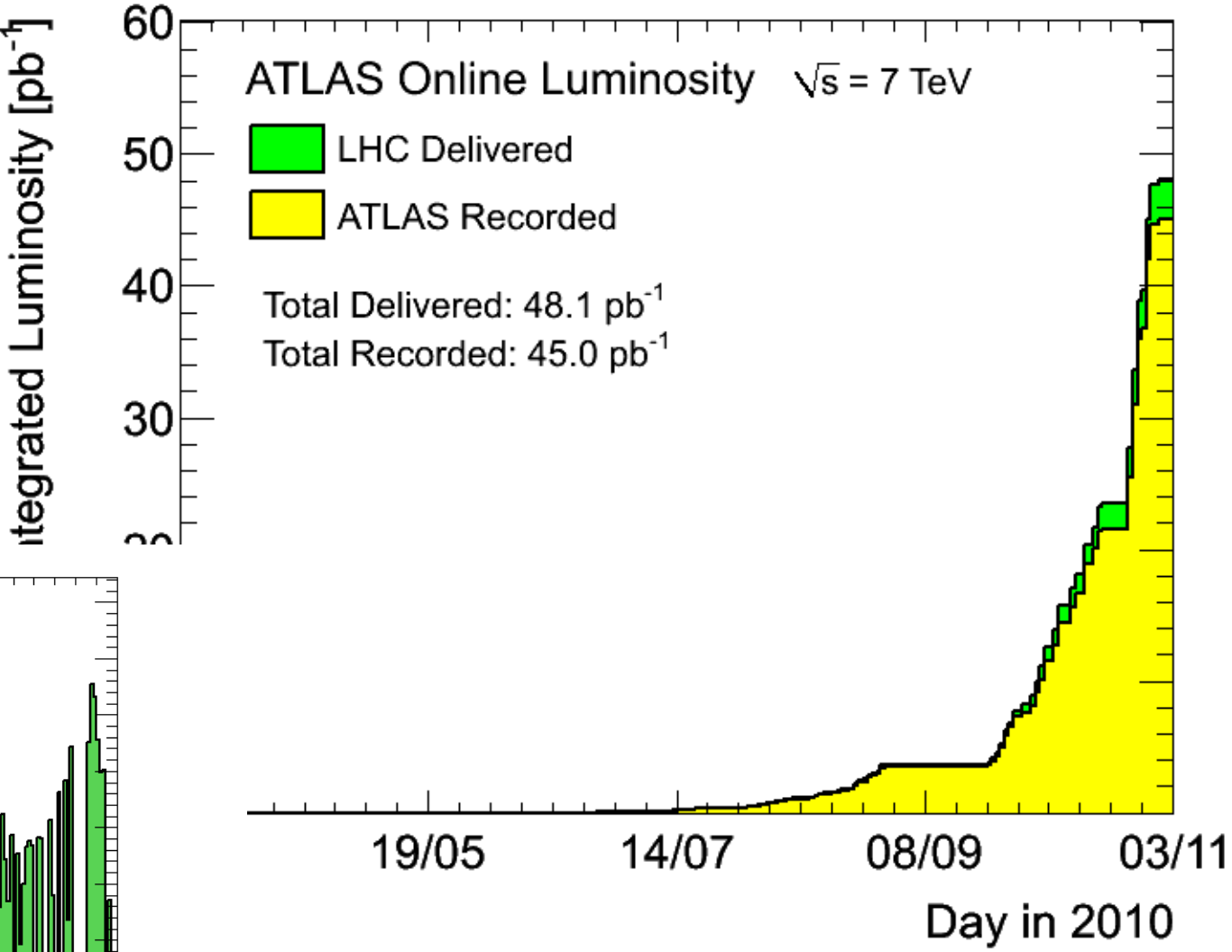
SCT barrel test setup

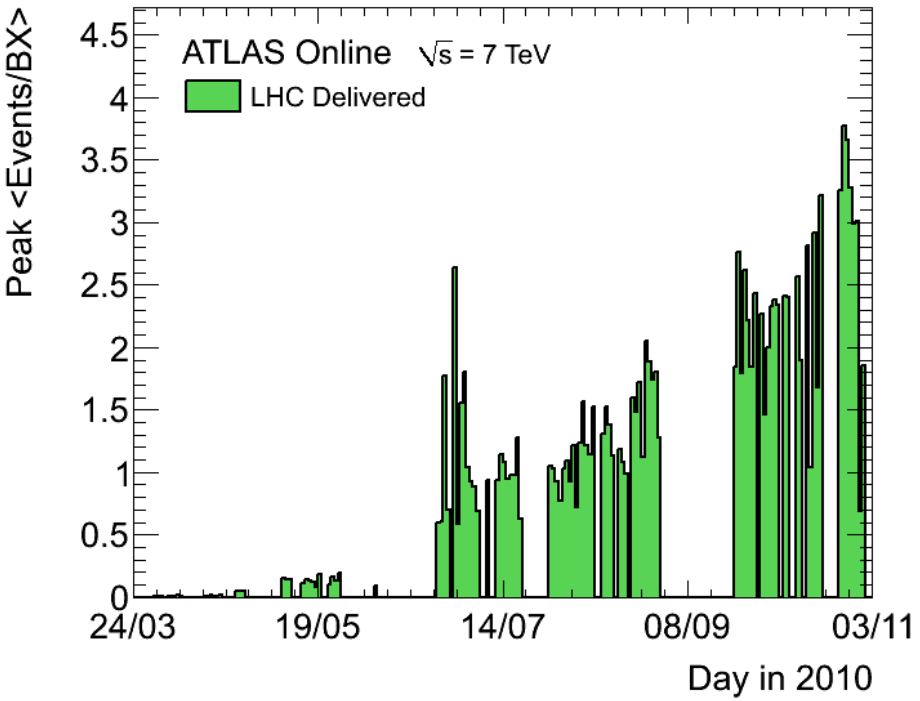
One SCT barrel, before mounting detector modules, showing opto-harnesses

Data Collected: 2010

Data-taking efficiency
94%

Half the integrated luminosity was delivered in the last week (25pb^{-1})
Bodes well for 2011





Pileup: mean interactions / beam-crossing - up to 3-4

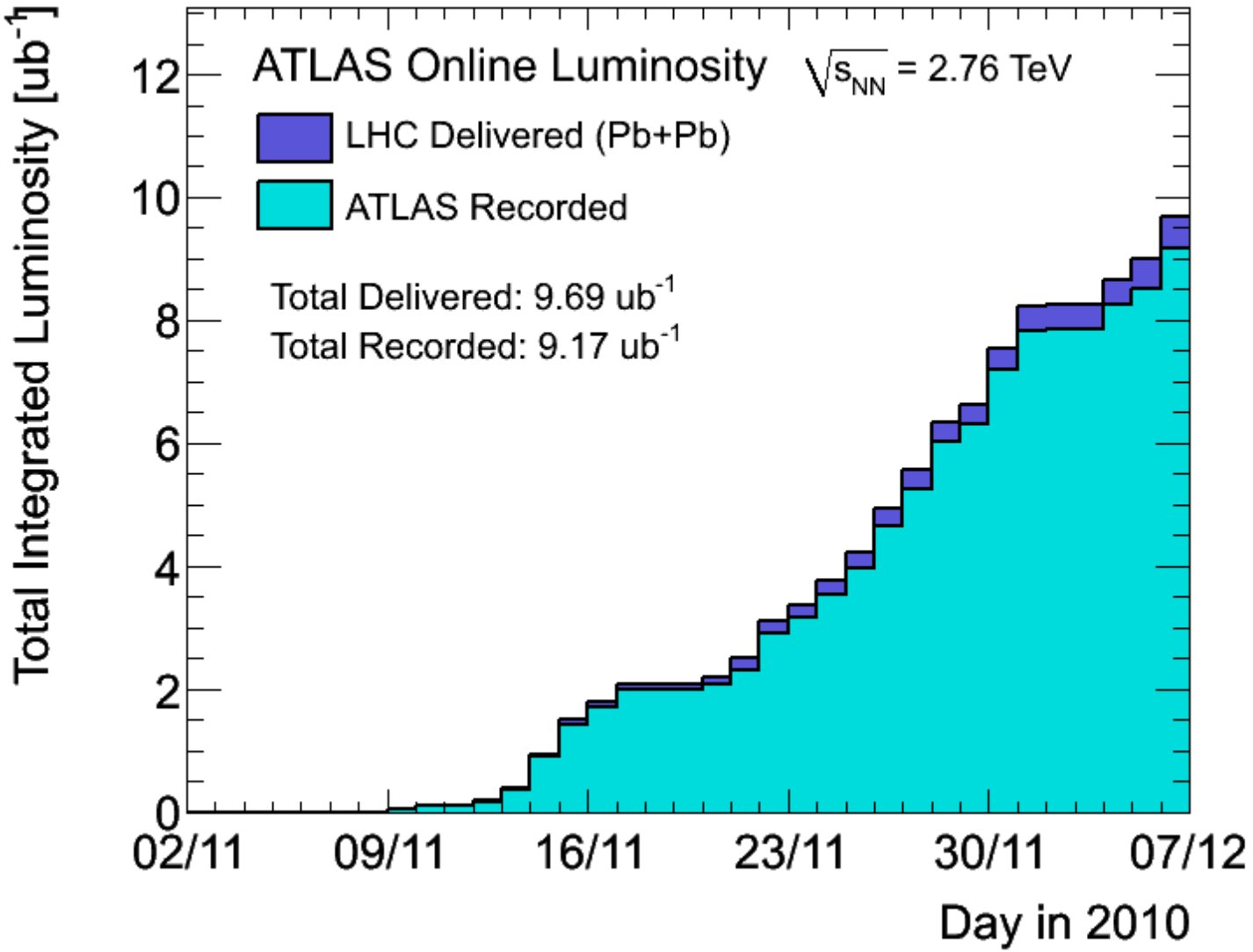
Heavy Ion Data

Pb-Pb collisions

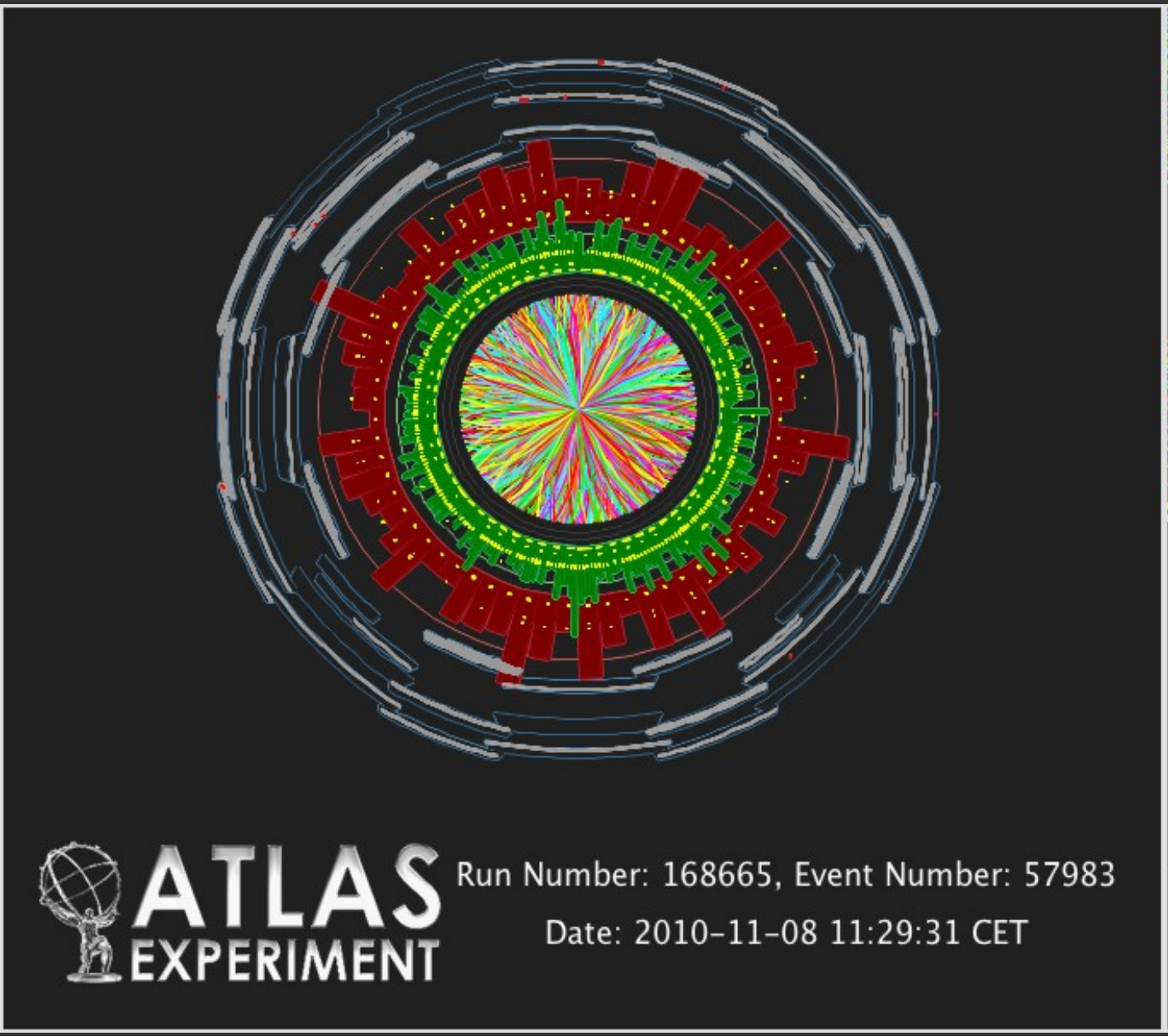
Inclusive cross-section ~ 8 barns

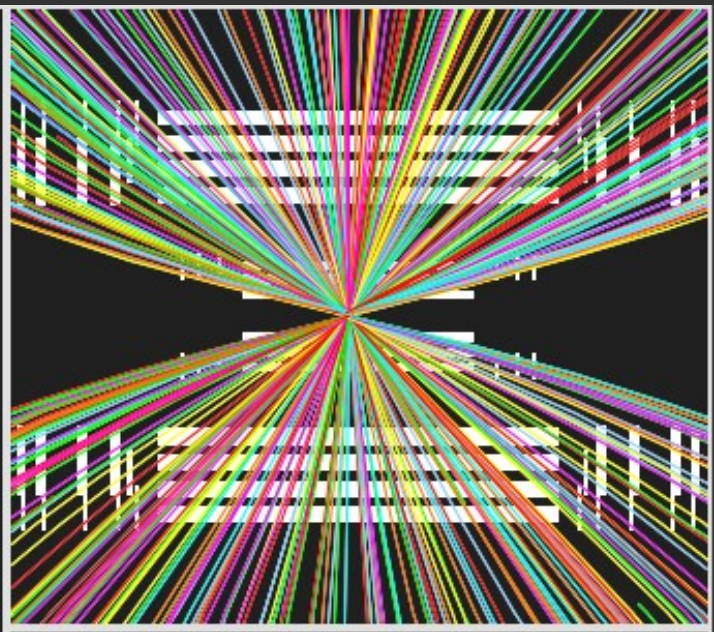
Luminosity was low, so we could use a very open trigger for the full period

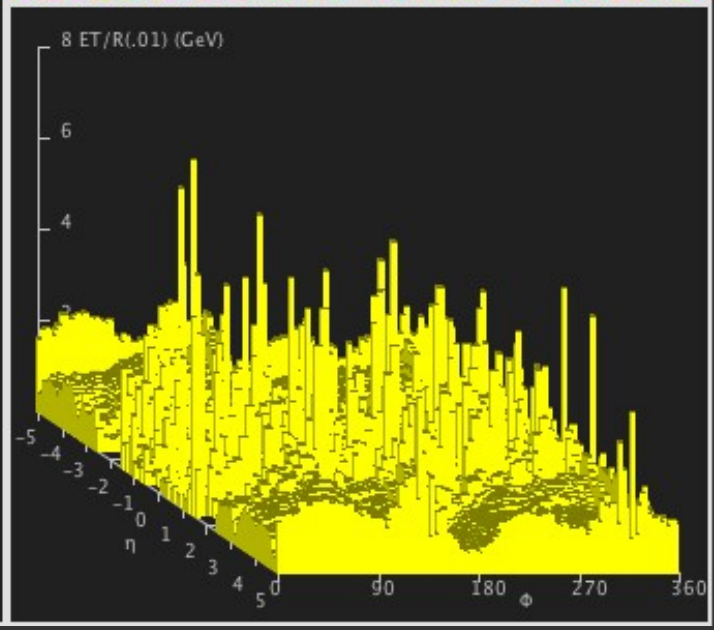
Data-taking efficiency 95%



Pb-Pb Collision Event







Detectors Operational

97-100% operational channels for all detector systems

85-95% data-taking efficiency

Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	80 M	97.3%
SCT Silicon Strips	6.3 M	99.2%
TRT Transition Radiation Tracker	350 k	97.1%
LAr EM Calorimeter	170 k	97.9%
Tile calorimeter	9800	96.8%
Hadronic endcap LAr calorimeter	5600	99.9%
Forward LAr calorimeter	3500	100%
LVL1 Calo trigger	7160	99.9%
LVL1 Muon RPC trigger	370 k	99.5%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	350 k	99.5%
CSC Cathode Strip Chambers	31 k	98.5%
RPC Barrel Muon Chambers	370 k	97.0%
TGC Endcap Muon Chambers	320 k	98.4%

Inner Tracking Detectors			Calorimeters				Muon Detectors			
Pixel	SCT	TRT	LAr EM	LAr HAD	LAr FWD	Tile	MDT	RPC	CSC	TGC
99.1	99.9	100	90.7	96.6	97.8	100	99.9	99.8	96.2	99.8

Luminosity weighted relative detector uptime and good quality data delivery during 2010 stable beams in pp collisions at $\sqrt{s}$=7 TeV between March 30th and October 31st (in %). The inefficiencies in the LAr calorimeter will partially be recovered in the future.

Data quality (pp data)

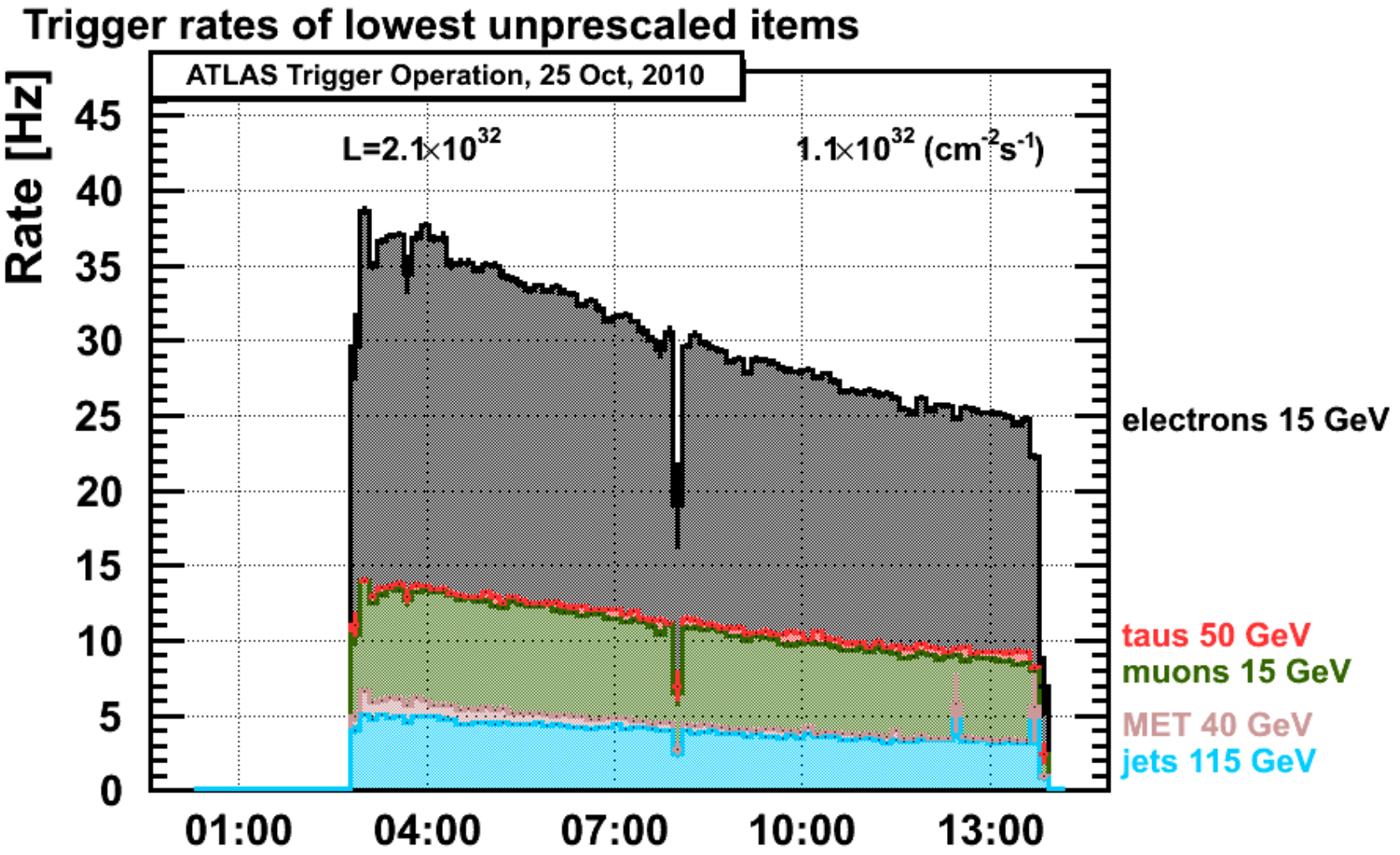
Dave Charlton, 26 January 2011

Trigger Operation

Much evolution of trigger during 2010: factor 10^5 increase in instantaneous luminosity $2\times10^{27} \rightarrow 2\times10^{32}$ $cm^{-2}s^{-1}$

Flexible trigger system: raising thresholds, increasing use of HLT rejection power

Trigger operation example: highest lumi fill in 2010

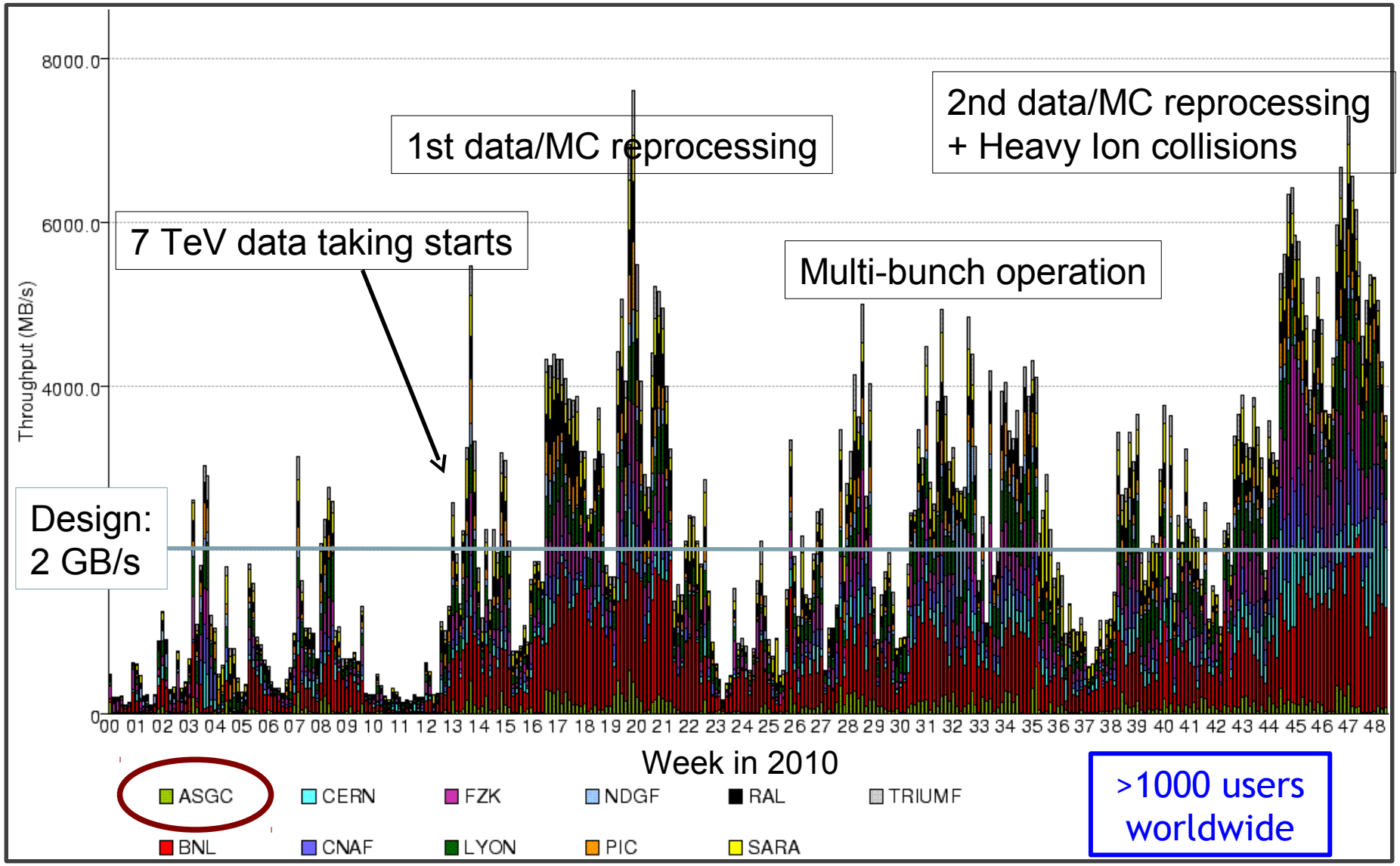


LHC Computing Grid

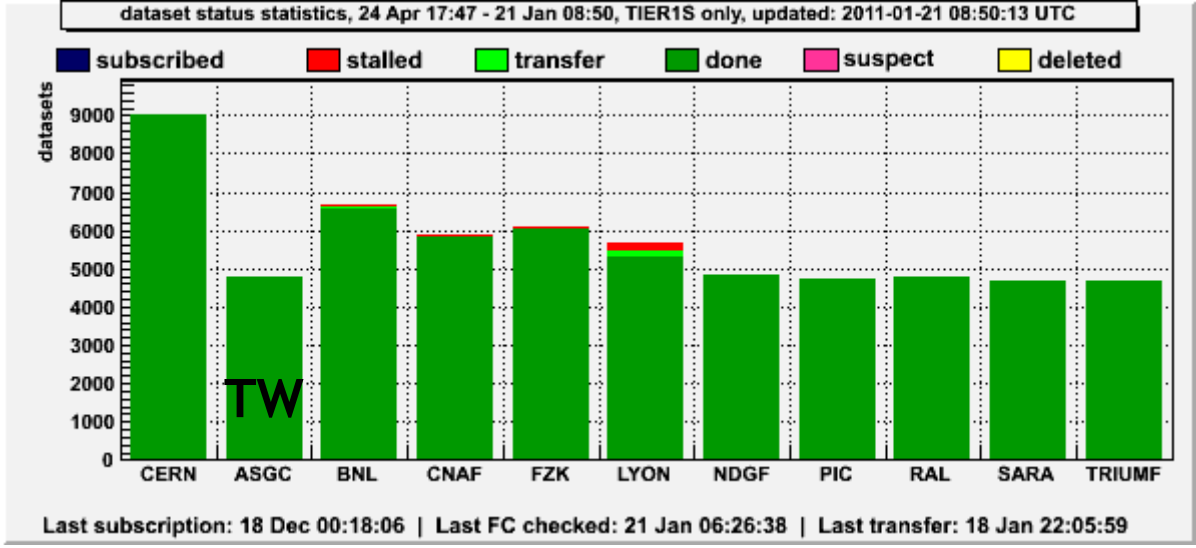
ATLAS has ten Tier-1 sites including ASGC Taipei

Computing Operations

Throughput of ATLAS data through the GRID in 2010



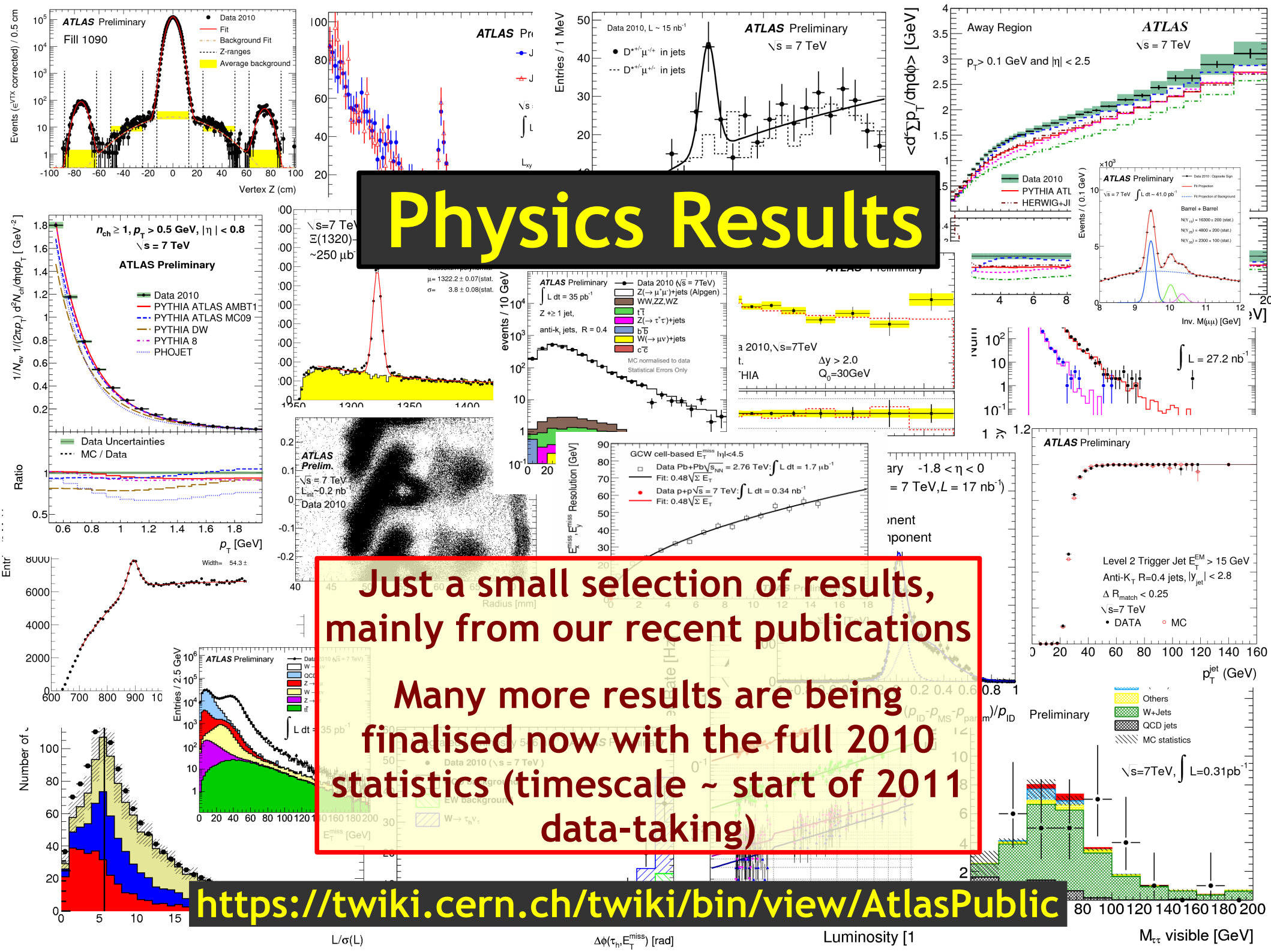
2010 Data Reprocessing



date-tier	CA	CERN	DE	ES	FR	IT	ND	NL	TW	UK	US	sum
10-10-30	88	0	974	976	908	1047	945	1934	2199	3355	2760	15186
10-10-31	2541	0	1	212	579	77	1475	2272	85	3249	11006	21497
10-11-01	2530	0	3619	73	7420	4448	628	3737	1866	3024	8004	35349
10-11-02	2714	109	5649	954	4463	3771	1295	2154	2670	5720	7902	37401
10-11-03	4891	40	9952	4590	2554	27	1924	2903	2003	3250	14146	46280
10-11-04	7	0	3625	163	3209	17	1511	842	2225	1	15809	27409
10-11-05	1539	10	0	4043	4317	922	2836	2564	1927	9574	21384	49116
10-11-06	2989	0	3598	4598	10722	3309	2482	1029	2584	11235	4648	47194
10-11-07	6917	0	5722	3943	7191	2801	4073	0	2554	20794	14315	68310
10-11-08	6749	0	15858	3643	5807	7003	6103	4084	334	8655	15161	73397
10-11-09	24	3989	1432	3180	6752	319	219	7075	597	298	19584	43469
10-11-10	0	6587	1	4	3026	2	7	9304	1806	193	7777	28707
10-11-11	0	5517	0	3	58	0	1	14324	2722	9	24361	46995
10-11-12	0	2	0	0	239	0	0	6994	2077	0	13677	22989
10-11-13	0	0	0	0	7164	0	0	979	638	0	0	8781
10-11-14	0	0	0	0	4906	0	0	663	0	0	0	5569
10-11-15	0	0	0	0	9402	0	0	0	0	0	0	9402
10-11-16	0	0	0	0	63	0	0	0	0	0	0	63
10-11-17	0	0	0	0	1	0	0	0	0	0	0	1
total jobs	30992	16256	50434	26385	78788	23745	23503	60864	26289	69361	180544	587161
total done	30989	16254	50431	26382	78781	23743	23499	60858	26287	69357	180534	587115
%%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
aborted	3	2	3	3	7	2	4	6	2	4	10	46
%%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
running	0	0	0	0	0	0	0	0	0	0	0	0
%%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Reprocessing campaign in October/November 2010 to re-reconstruct full 2010 pp sample with updated alignment and calibration constants, improved code, etc

Processing shared across all ten ATLAS Tier-1 sites plus CERN


Physics Results
Just a small selection of results, mainly from our recent publications
Many more results are being finalised now with the full 2010 statistics (timescale ~ start of 2011 data-taking)
https://twiki.cern.ch/twiki/bin/view/AtlasPublic
ATLAS Preliminary
Fill 1090
Data 2010
Fit
Background Fit
Z-ranges
Average background
Vertex Z (cm)
Away Region
p_T> 0.1 GeV and |η| < 2.5
Data 2010
PYTHIA ATL
HERWIG+JI
Data 2010
PYTHIA ATLAS AMBT1
PYTHIA ATLAS MC09
PYTHIA DW
PYTHIA 8
PHOJET
Data Uncertainties
MC / Data
Ratio
Level 2 Trigger Jet E_T^{EM} > 15 GeV
Anti-K_T R=0.4 jets, $|y_{jet}|$ < 2.8
Δ R_{match} < 0.25
√s=7 TeV
DATA
MC
Others
W+Jets
QCD jets
MC statistics
√s=7TeV, ∫ L=0.31pb^{-1}
Preliminary
Luminosity [1
$M_{\tau\tau}$ visible [GeV]
L/σ(L)
$\Delta\phi(\tau_h, E_T^{miss})$ [rad]

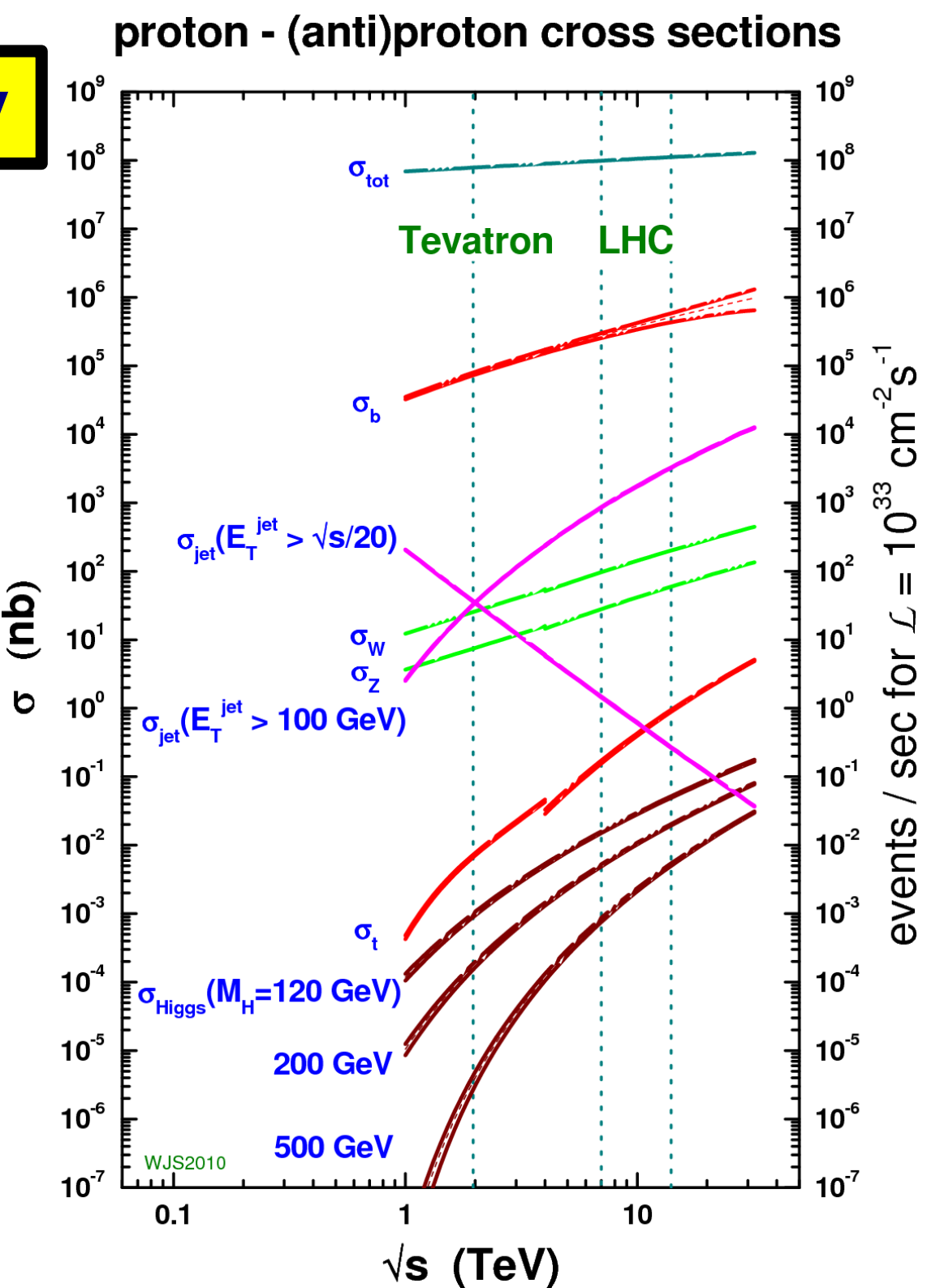
Physics Strategy

Strategy for *reliable and fast* results:

- **Observe and measure known processes in the new high-energy regime**
- *Requires detailed detector and performance understanding*

- **Probe for deviations or excesses that can signify new physics**
- *Use data to understand backgrounds as far as possible*

Measurements go *alongside* searches for new physics



Inclusive Charged Particles

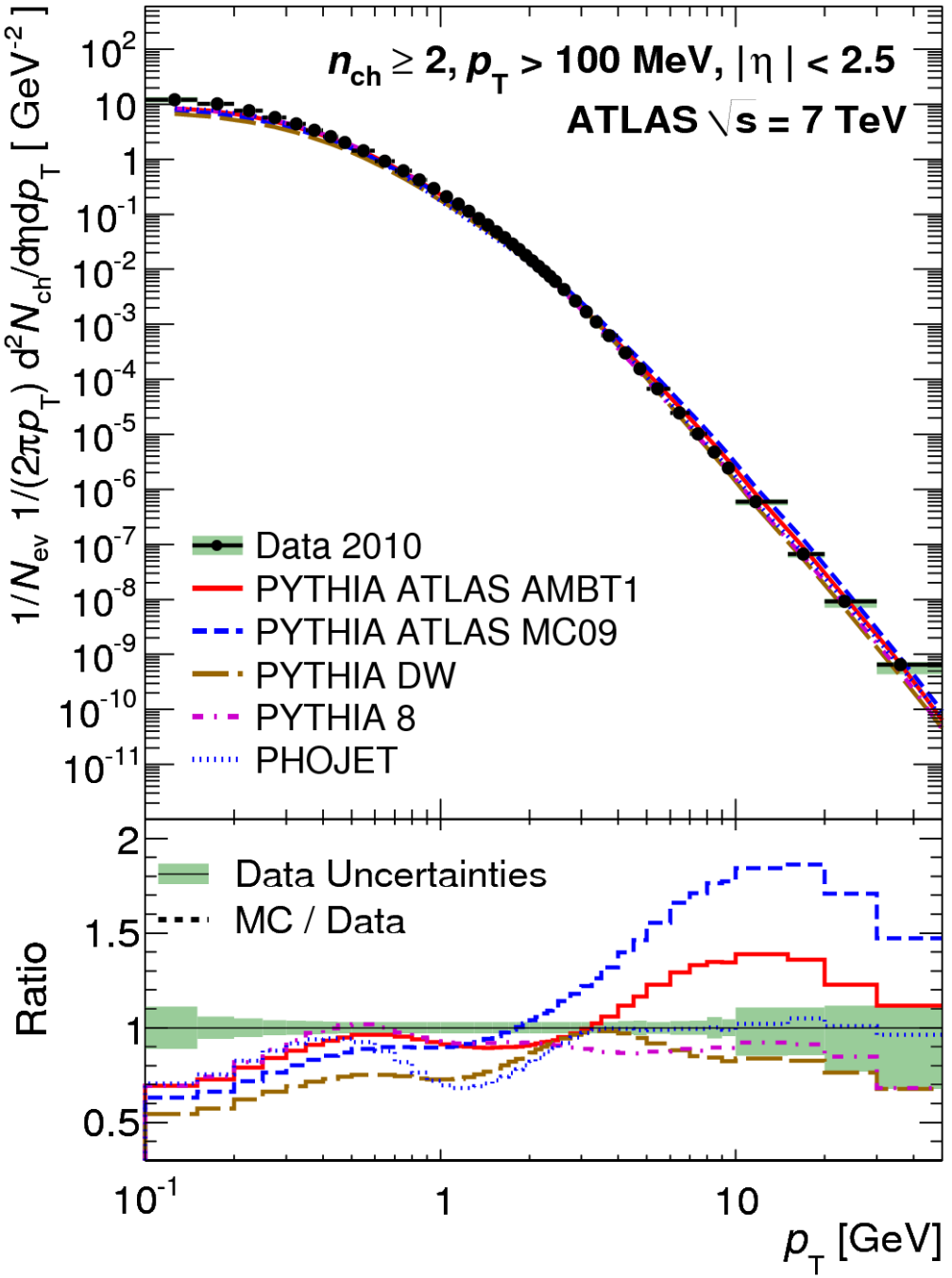
"Minimum Bias" measurements

ATLAS strategy:

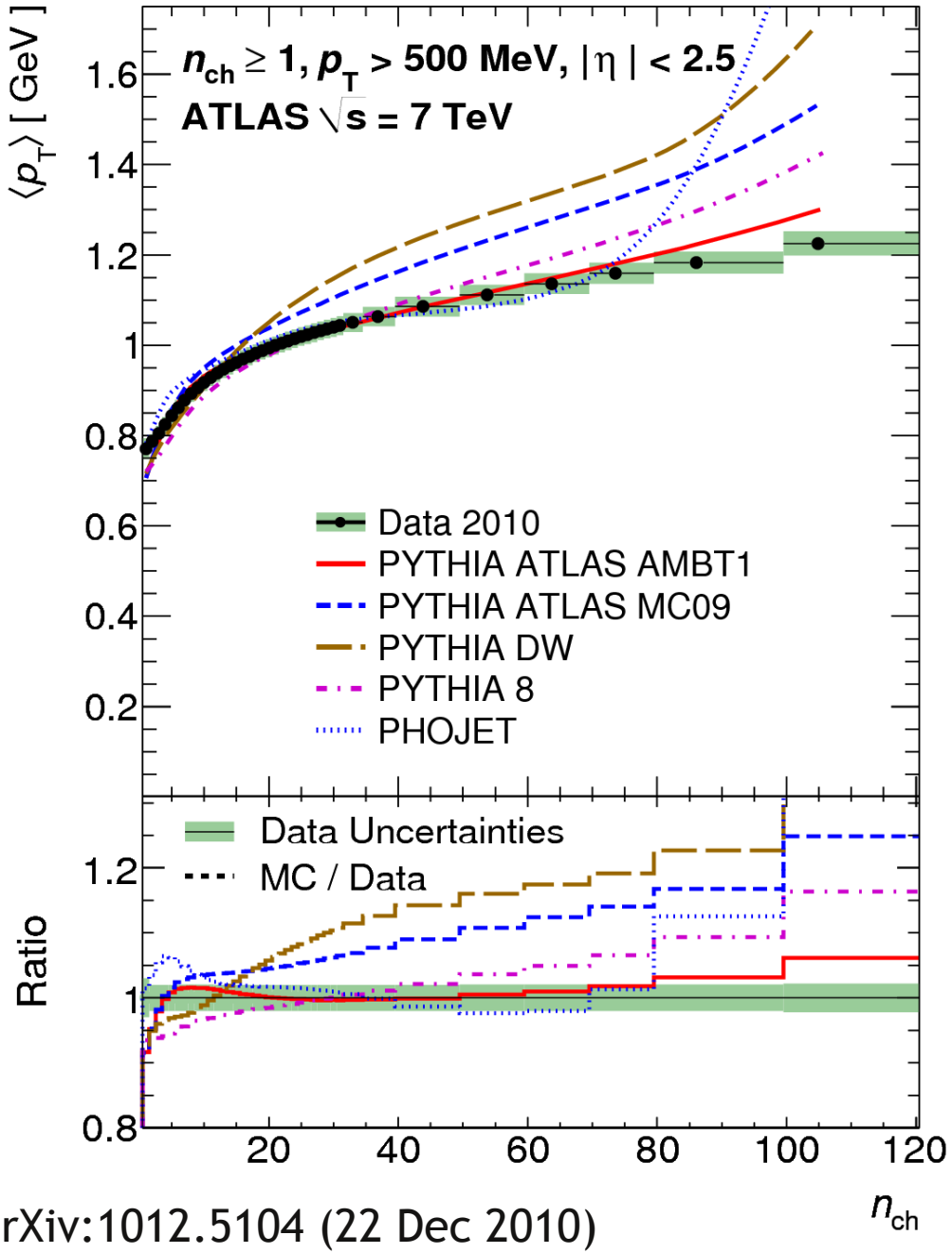
- Define several fiducial acceptances
- Correct for detector/trigger effects within these acceptances
- Use data to measure inefficiencies where possible (trigger, vertexing)
- Do not correct for unmeasured regions
- Do not correct for model-dependent diffractive effects, instead define acceptances with different amounts of diffraction

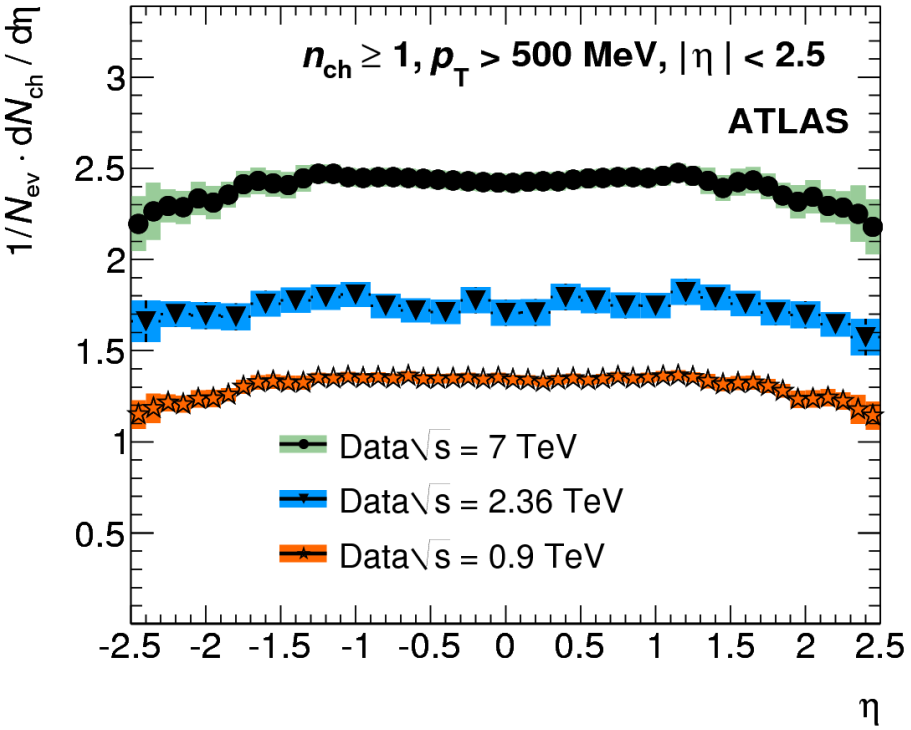
Measurements at $\sqrt{s}$=0.9, 2.36 and 7 TeV

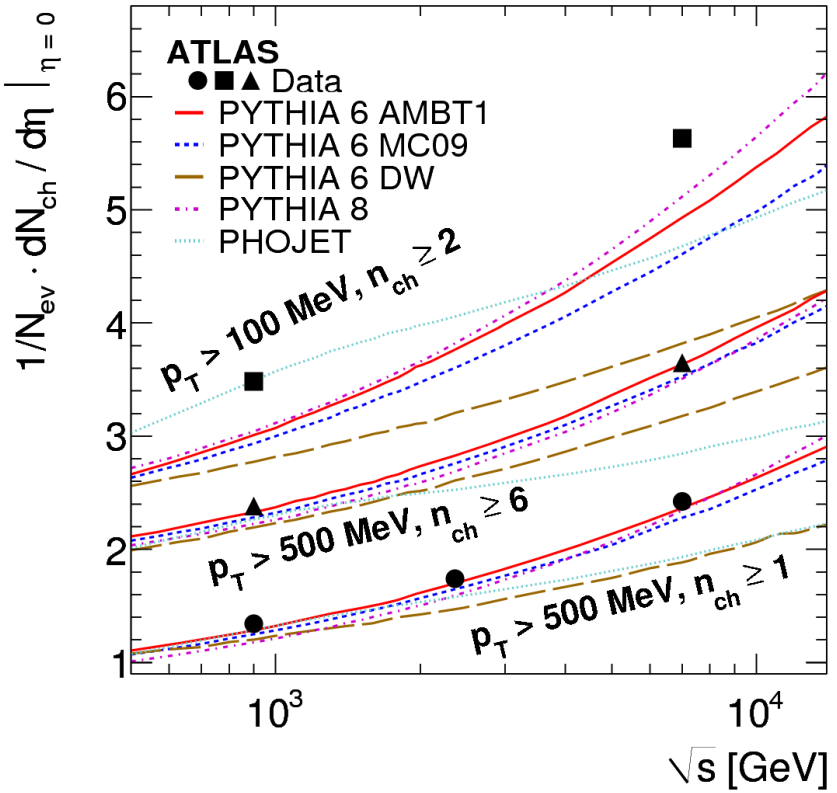
Strong discrimination between MC tunes – no tune describes all features well



arXiv:1012.5104 (22 Dec 2010)







arXiv:1012.5104 (22 Dec 2010)

Also many other results on soft QCD – see **https://twiki.cern.ch/twiki/bin/view/AtlasPublic**

Jet Cross-Section

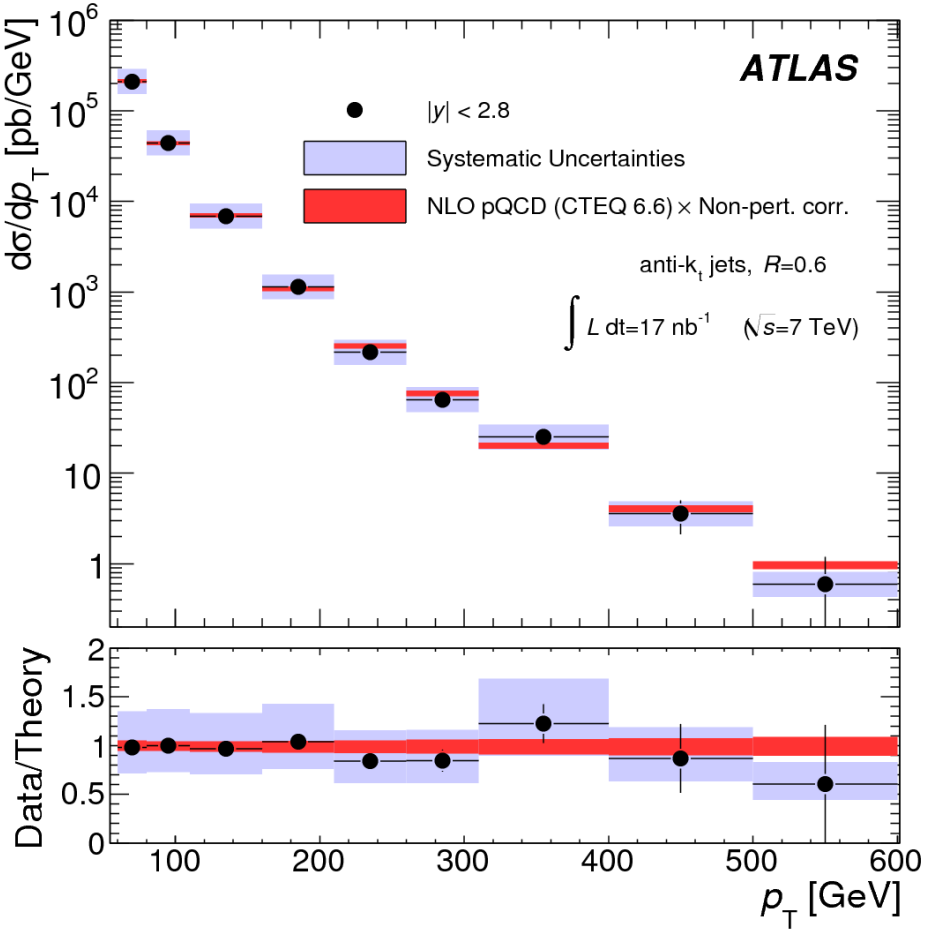
arXiv:1009.5908 (30 Sep 2010)

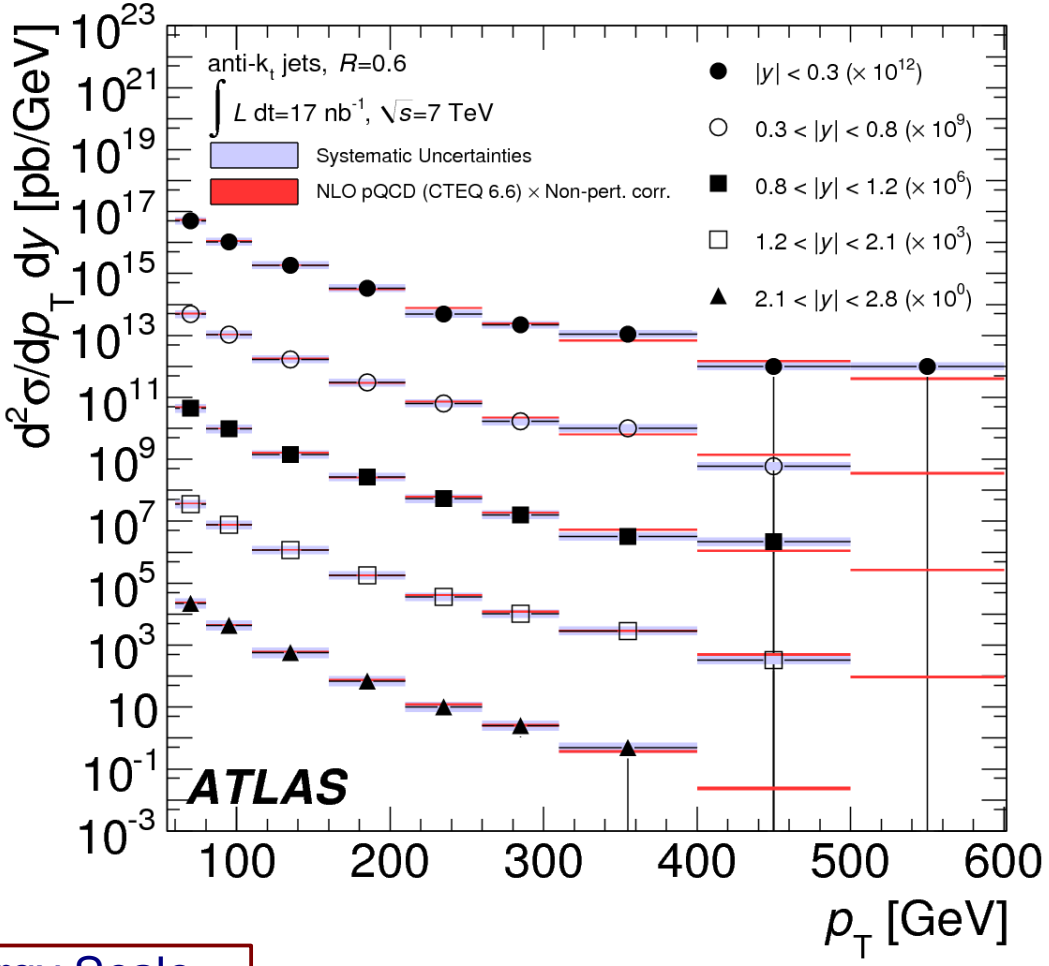
Jet cross-section is huge for medium p_T jets

First measurement paper on high-p_T process

Challenge was to understand jet energy scale/resolution

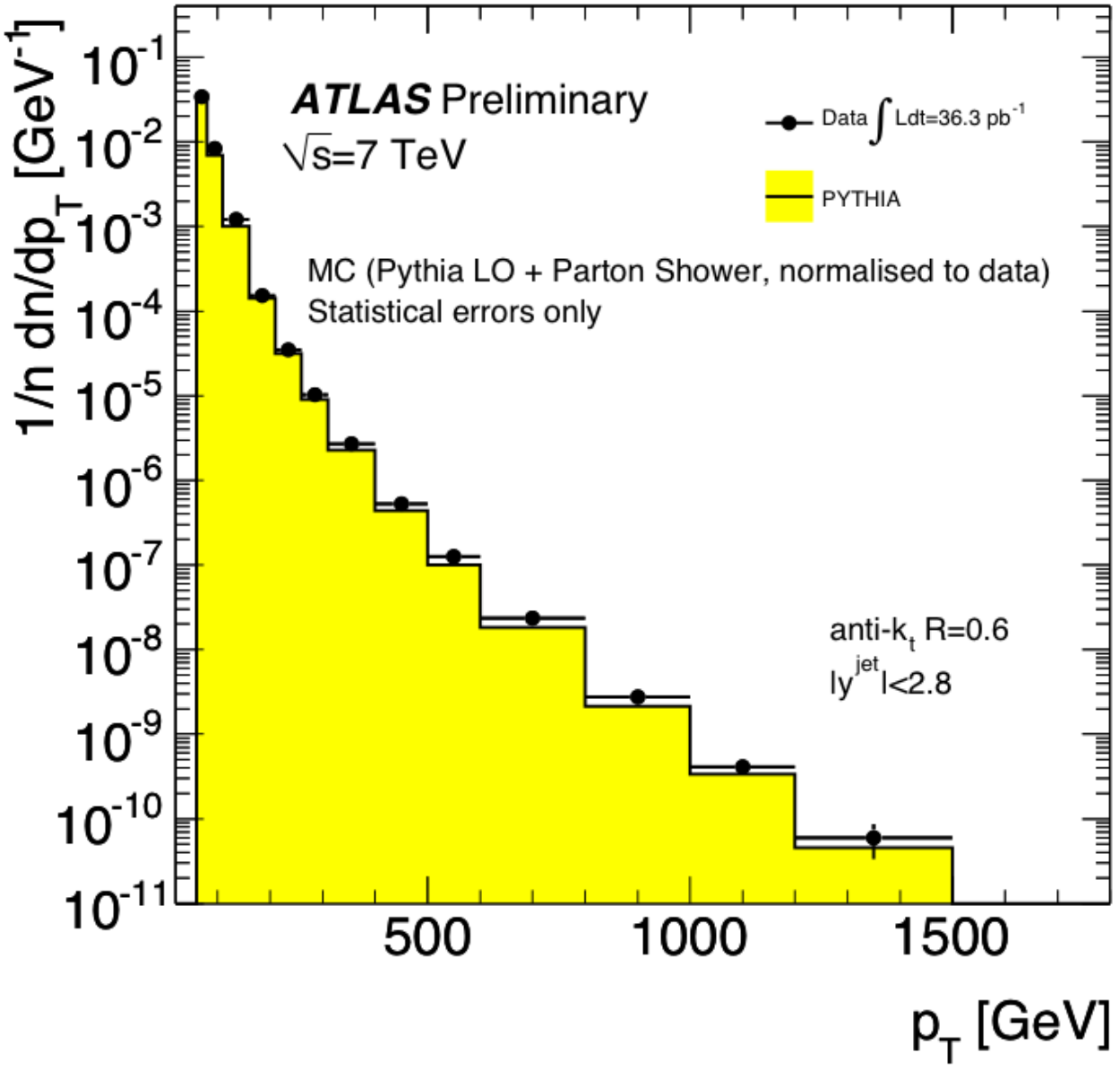
Fully corrected double-differential cross-sections
Anti-k_T jets, R=0.6





Uncertainty dominated by Jet Energy Scale
(summer 2010: ~7%, being reduced)

Inclusive Jet Distribution



Full 2010 statistics - more than 8 orders of magnitude

Shape compared to PYTHIA

Uncorrected for efficiency, acceptance, etc

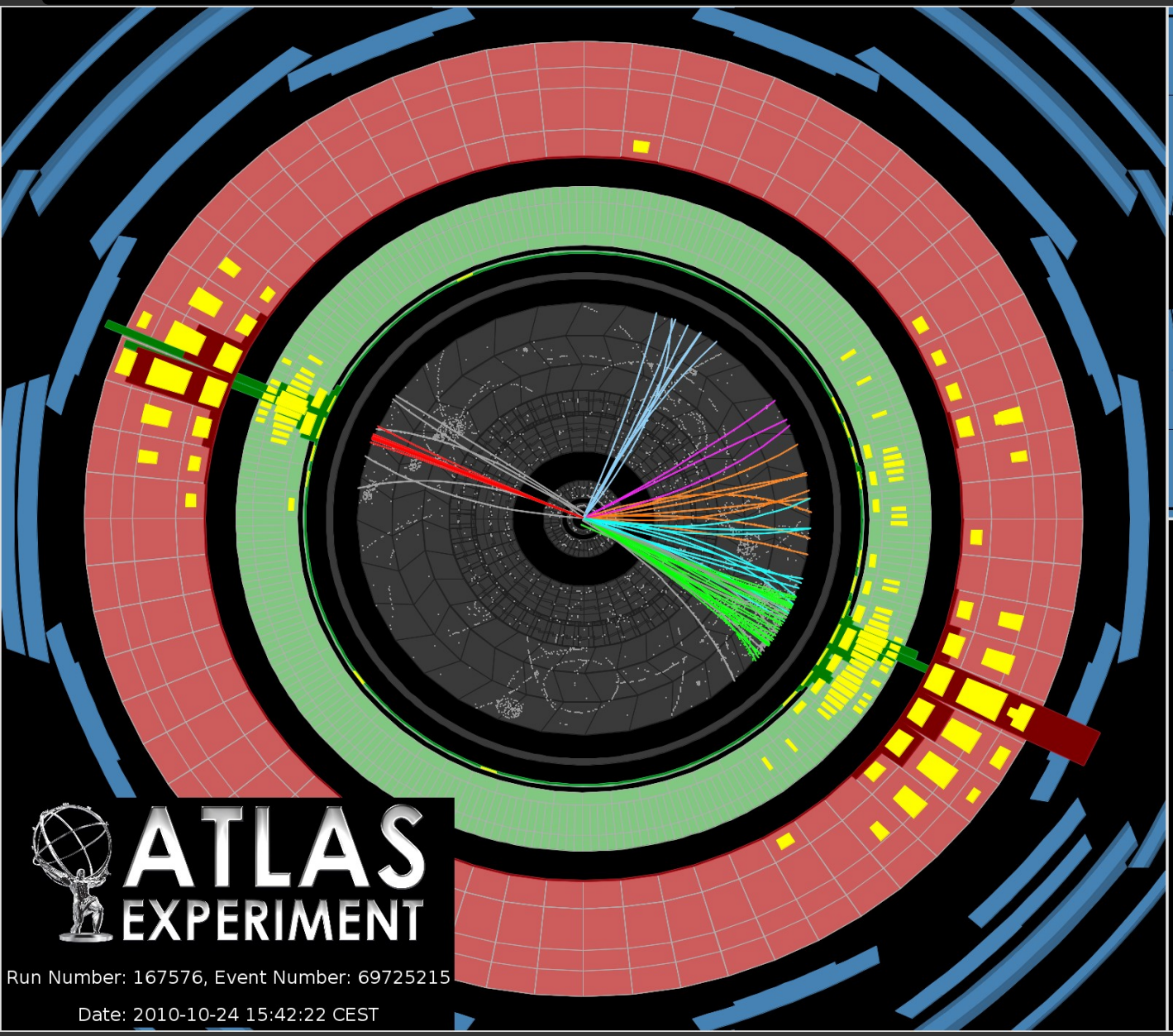
→ to come in next weeks

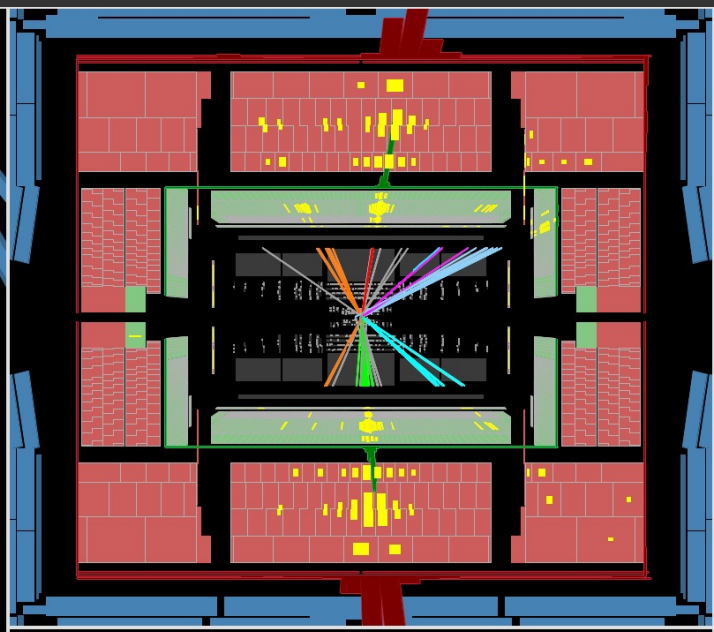
Highest p_T jet 1.3 TeV

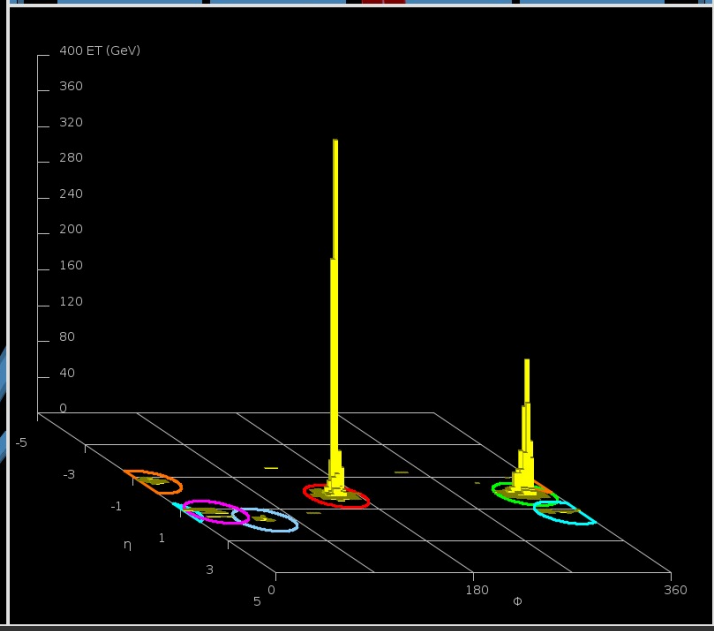
Highest p_T jet event

p_T jet1=1.3 TeV

(p_T jet2=1.2 TeV, m_{jj}=2.6 TeV)







Dijets and Multijets

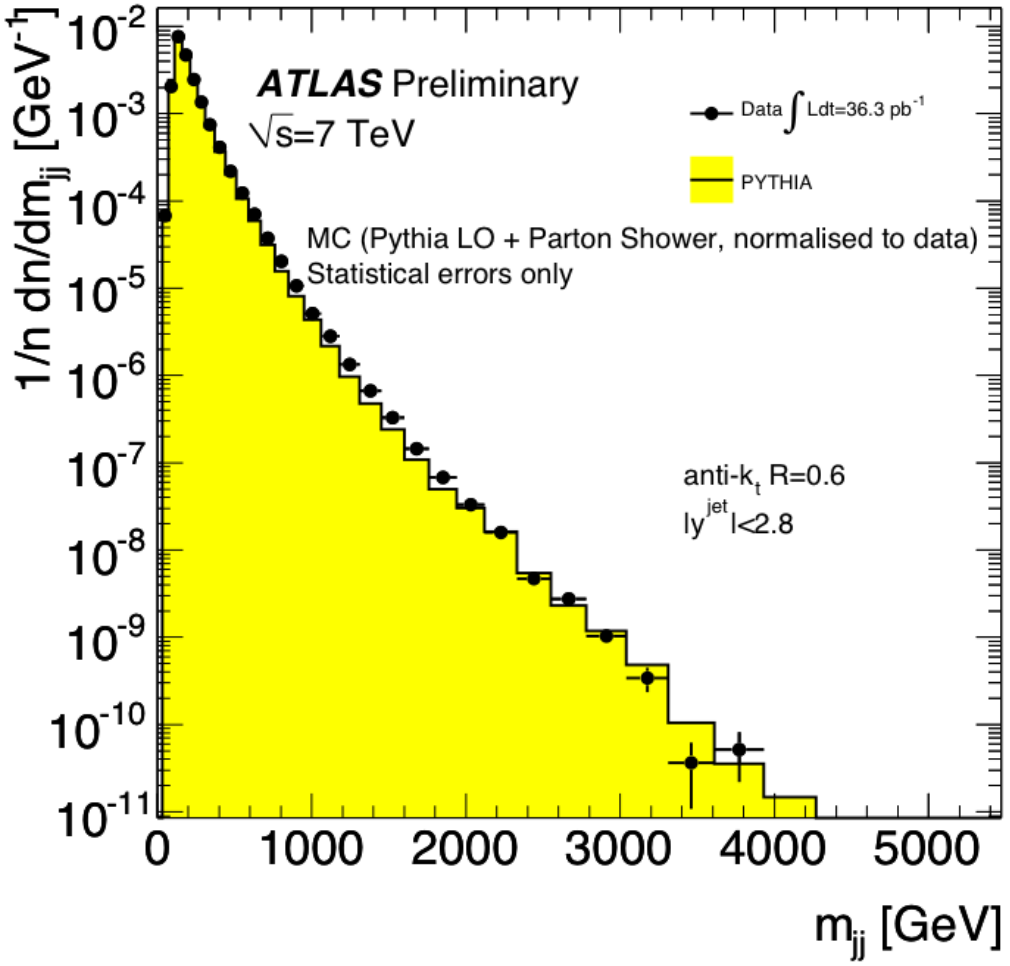
Leading jet p_T>60 GeV,

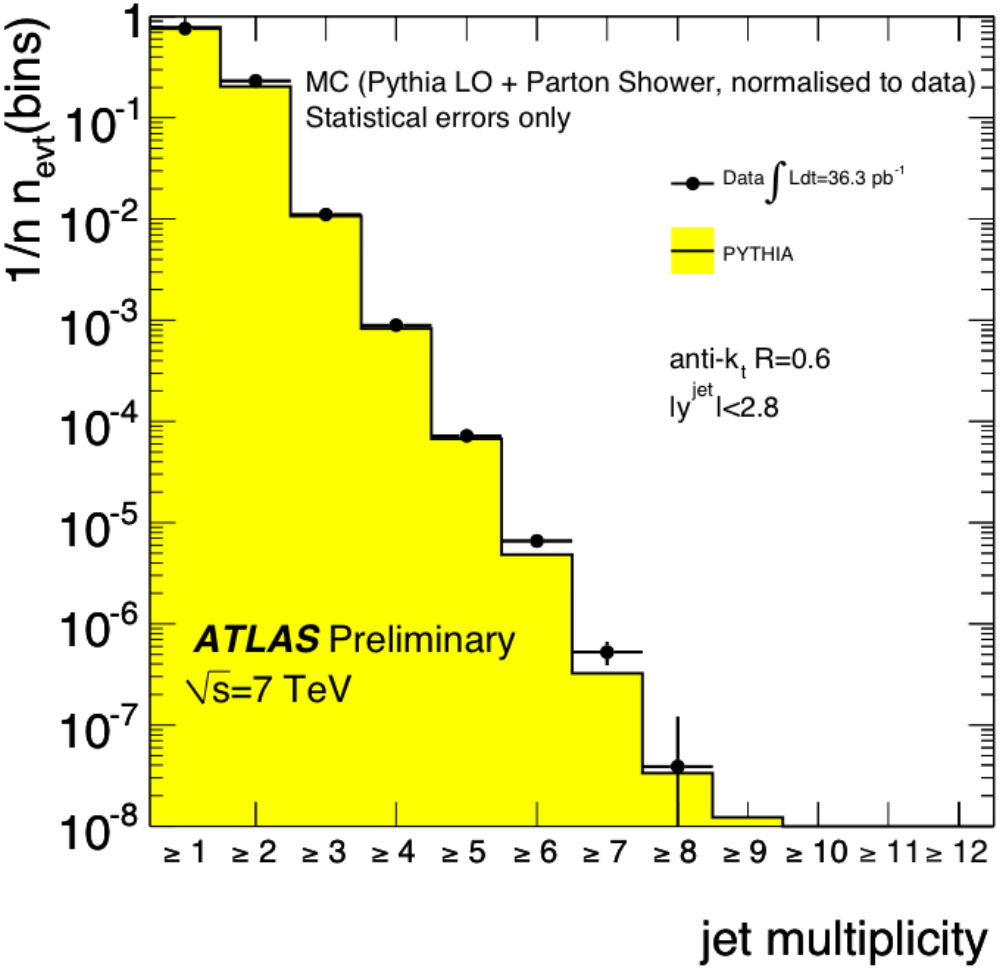
Subleading p_T>30 GeV

Highest dijet mass 3.7 TeV

Count jets with p_T>60 GeV and |y|<2.8

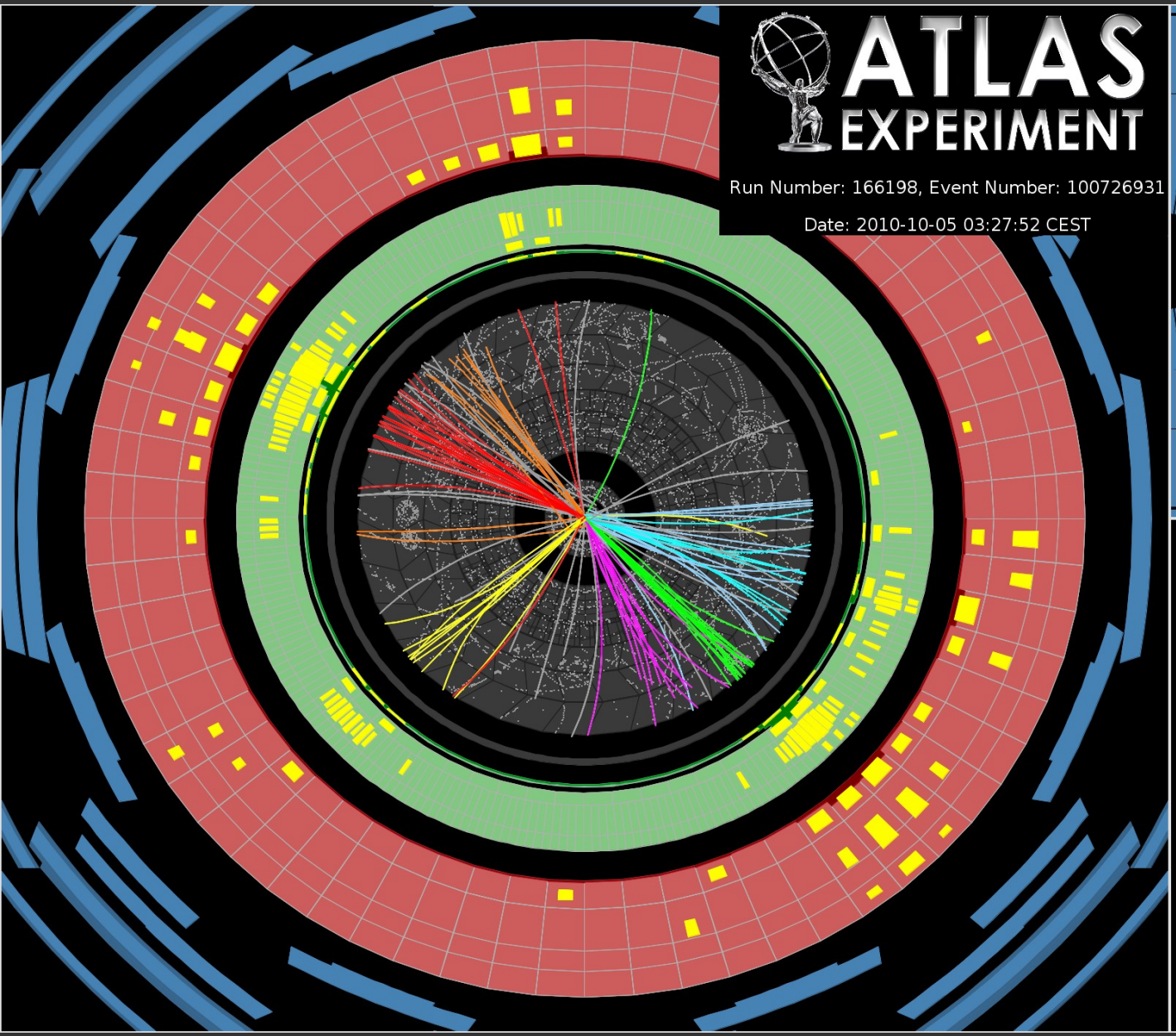
One event with 8 such jets

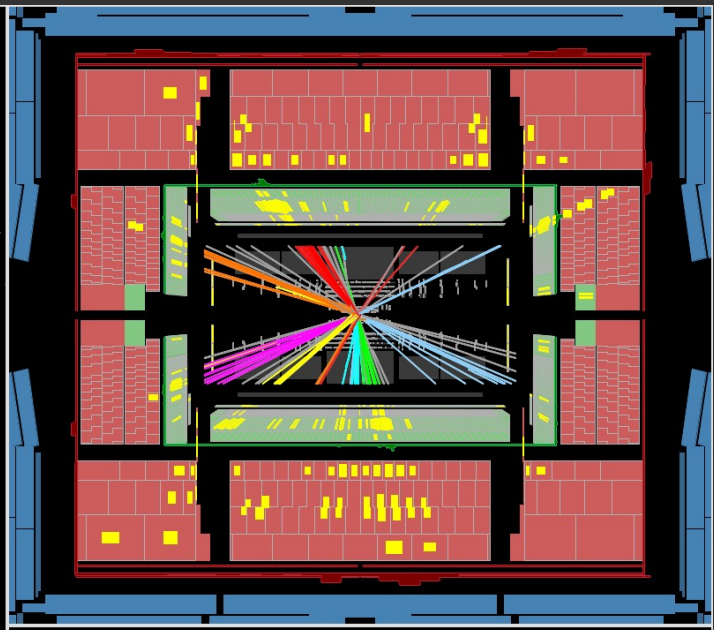


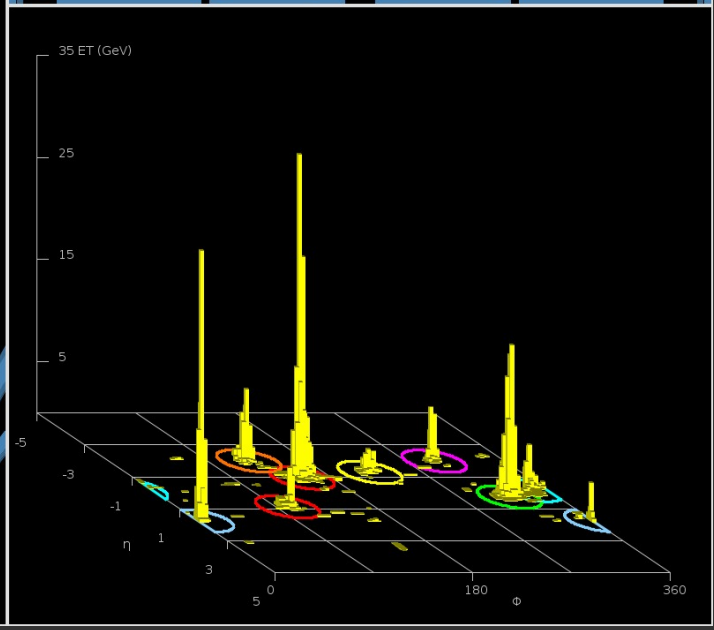


Eight-Jet Event

8 jets with p_T>60 GeV

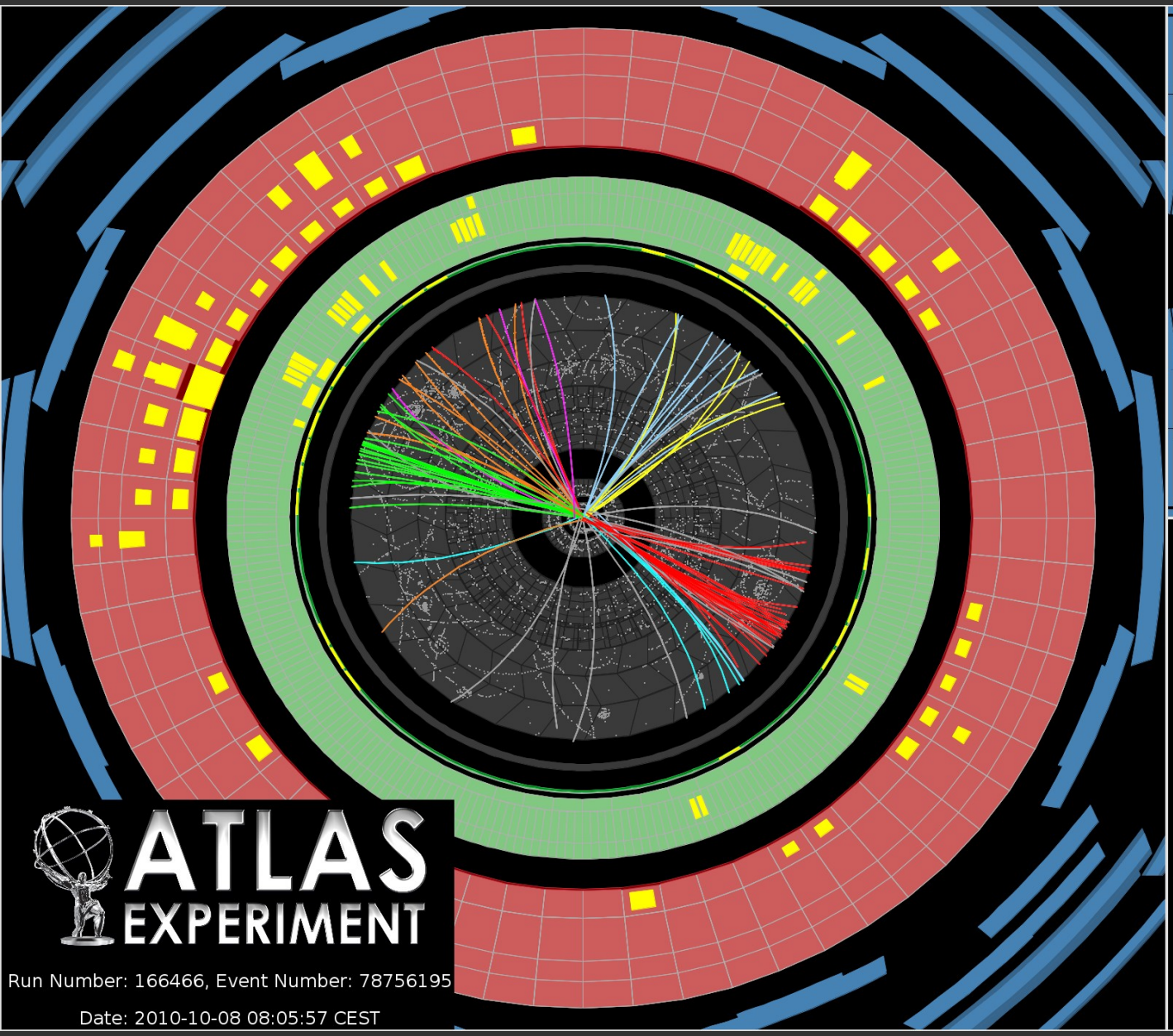


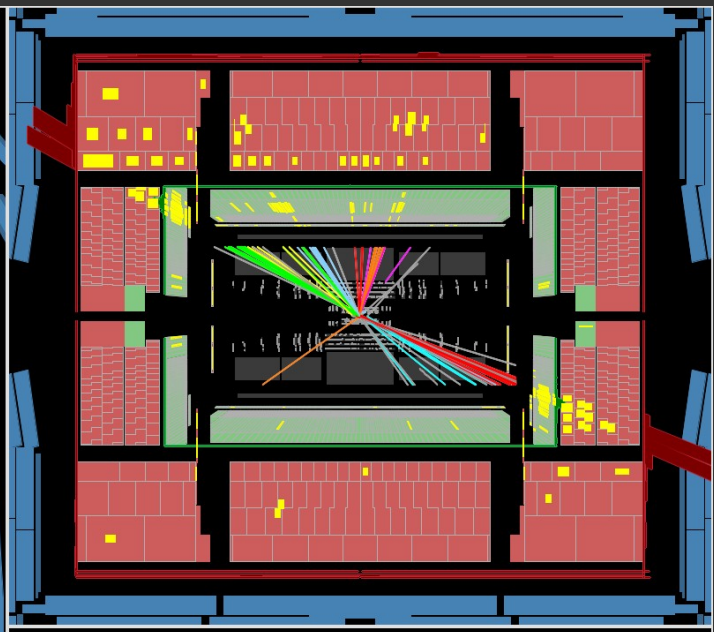


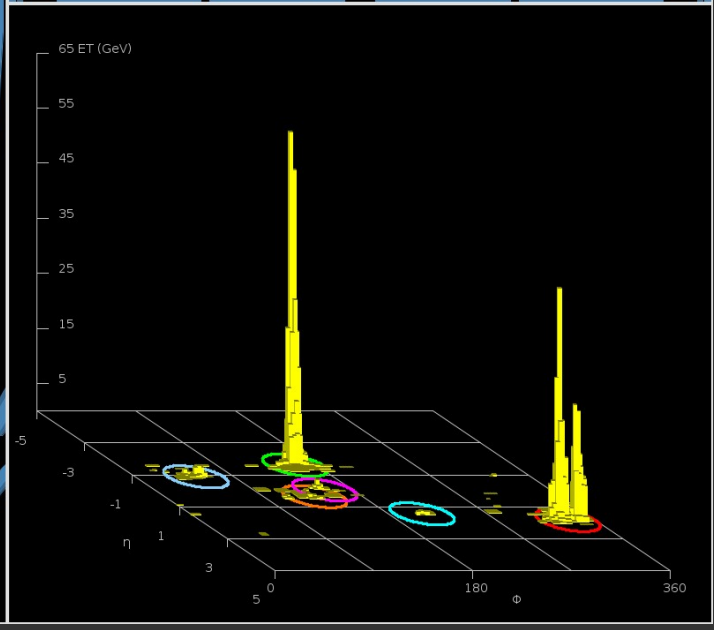


Highest-Mass Dijet

p_T jet1=670 GeV,
p_T jet2=610 GeV, m_{jj}=3.7 TeV





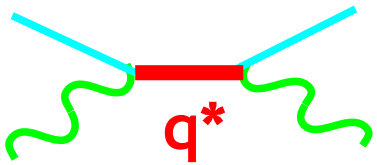


Dijet Mass Distributions

Sensitive to possible new physics beyond Tevatron (already in Aug. ~ 0.3 pb^{-1})

Phys Rev Lett 105, 161801

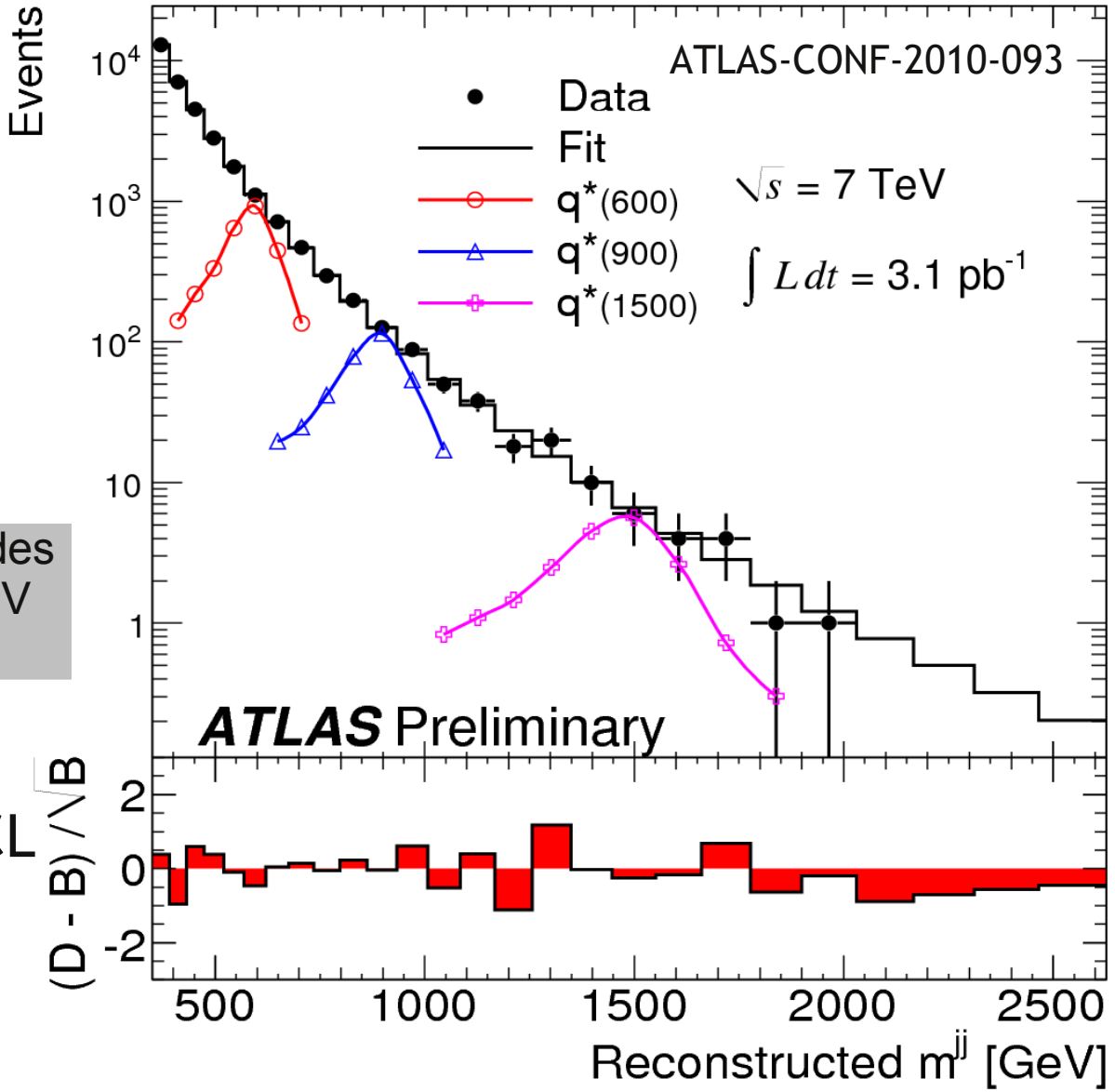
Model here s-channel q* production



Tevatron excludes m(q*)<0.87 TeV @ 95%CL

With 3 pb^{-1}, exclude at 95% CL

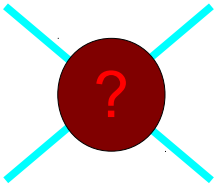
0.50 < m(q*) < 1.53 TeV



Dijet Angular Distributions

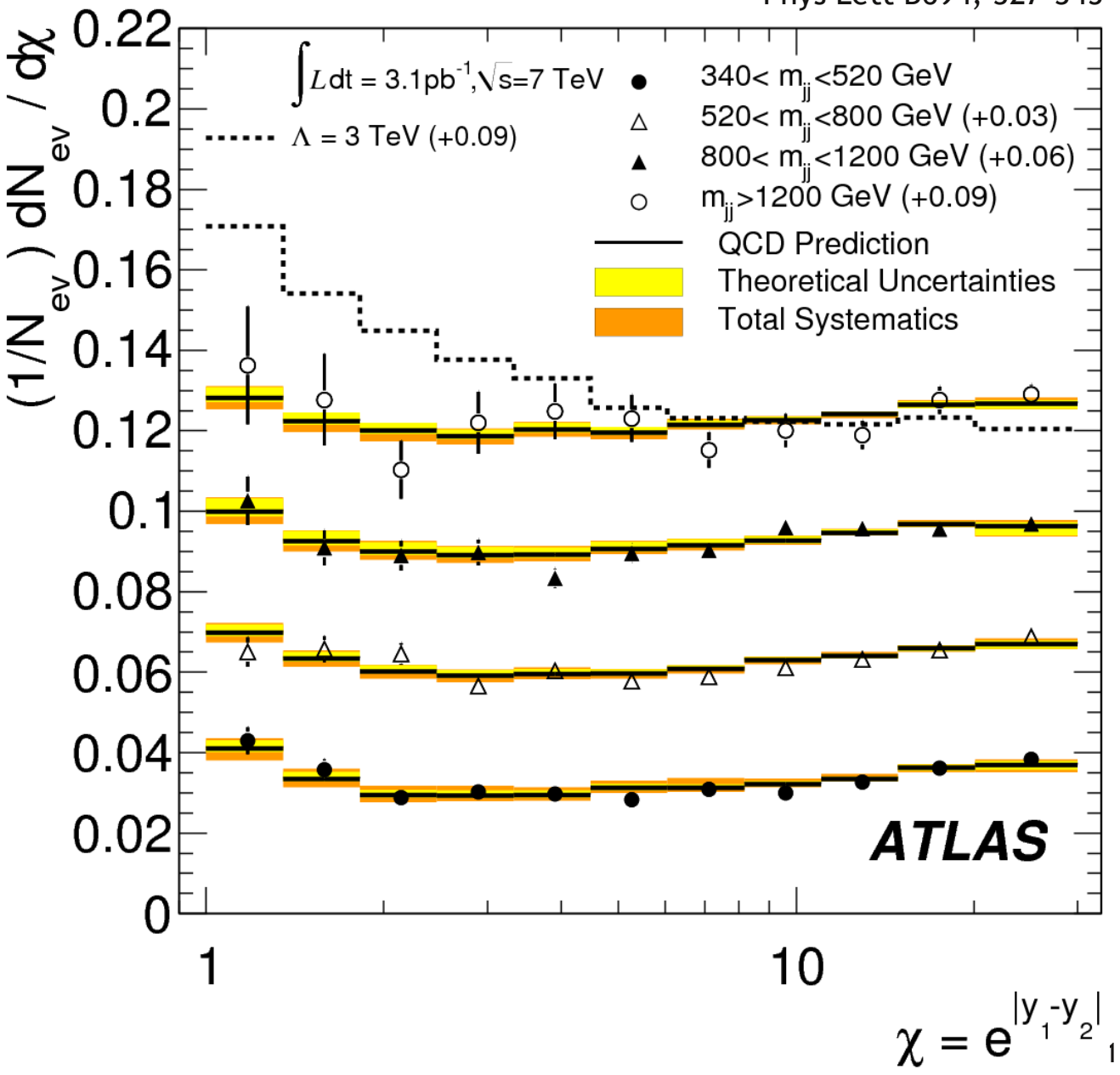
Phys Lett B694, 327-345

Potential 4-point contact interaction (CI) between quarks – characterised by scale Λ



Exclude quark CIs for
Λ < 3.4 TeV @ 95% CL

Tevatron excludes
Λ<3.1 TeV
@ 95%CL



Jet Shapes

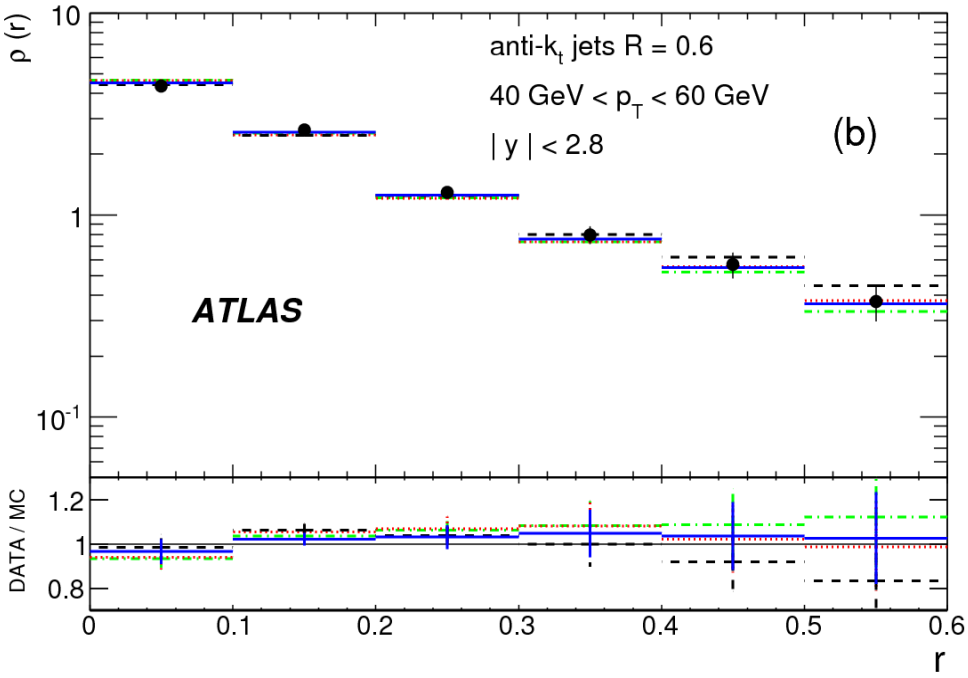
Measure fully corrected jet profiles: p_T flow in annular regions in (η,φ)-space around jet axis

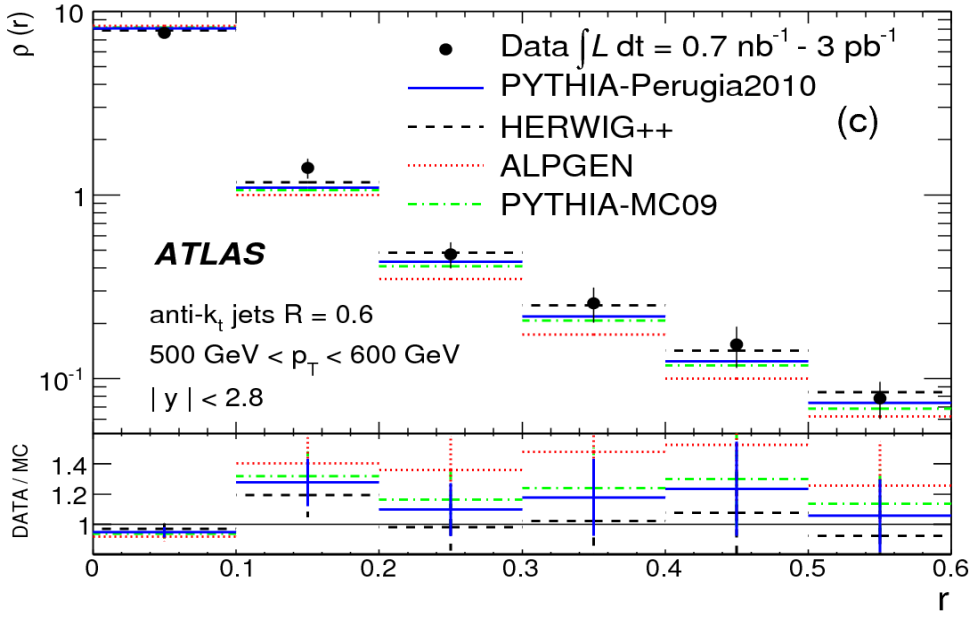
$30 < p_T^{jet} < 600$ GeV

Probes soft gluon radiation, underlying event activity and fragmentation effects

Higher-p_T and higher $|\eta|$ jets are narrower, broadly consistent with MC expectations

PYTHIA-Perugia2010 describes profiles well, ALPGEN and PYTHIA-MC09 tunes do less well



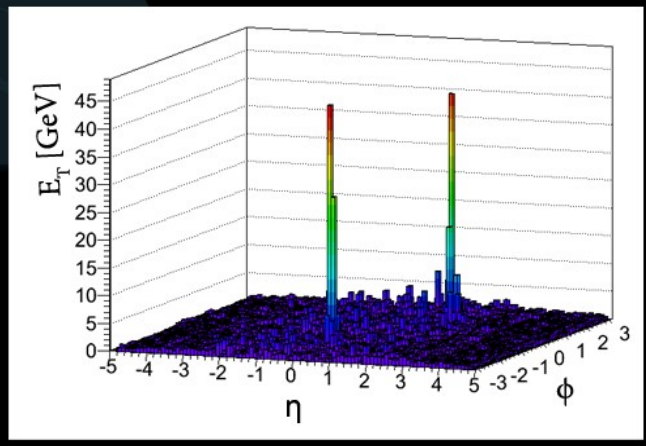


Pb-Pb Collision with Jets

Run 168875, Event 1577540
Time 2010-11-10 01:27:38 CET

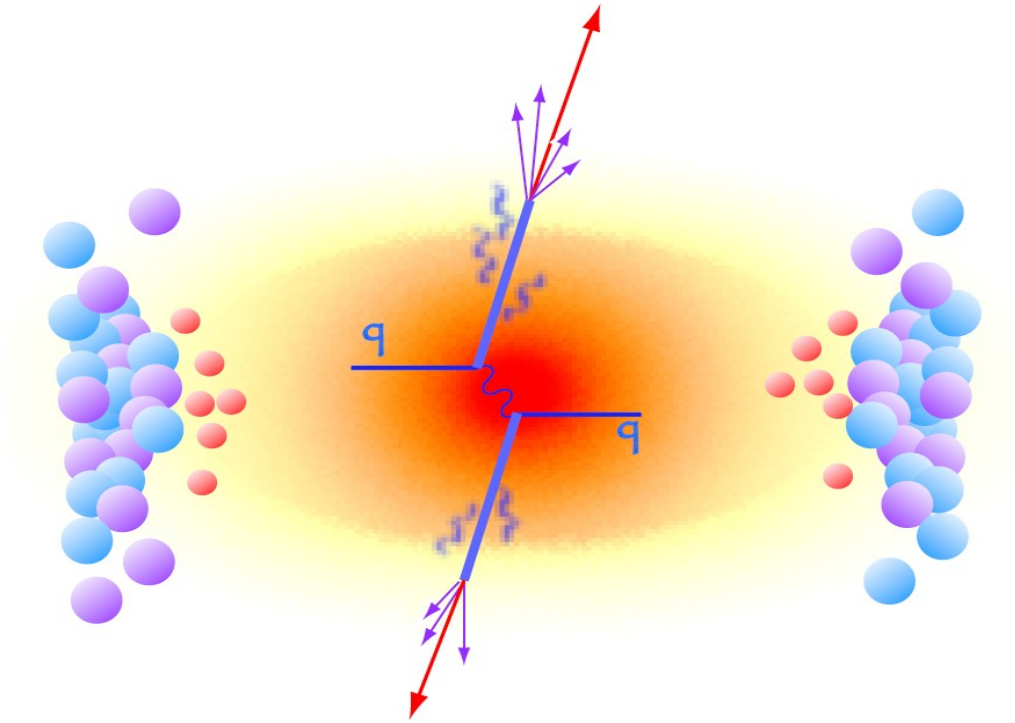
ATLAS EXPERIMENT

Jet p_T of ~160 GeV



Heavy Ion Collision Event with 2 Jets

Jet Quenching



Hard partonic scattering in central (head-on) Pb-Pb collisions

High energy partons propagating through a hot dense medium may lose energy through interactions – one or both jets may be "quenched"

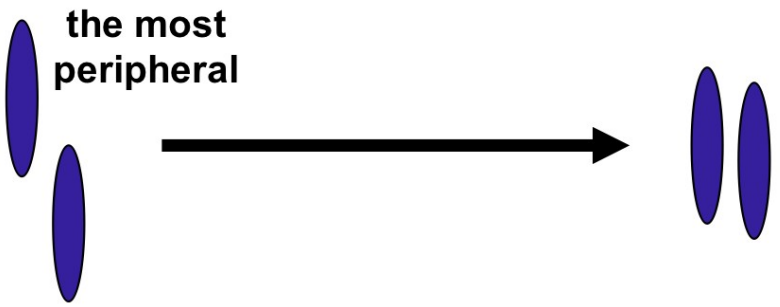
Expect effect to vary strongly with centrality of collision

$$A_J = \frac{E_{T1} - E_{T2}}{E_{T1} + E_{T2}}$$

Construct energy asymmetry A_J examine as a function of centrality

Heavy Ion Dijet Asymmetry

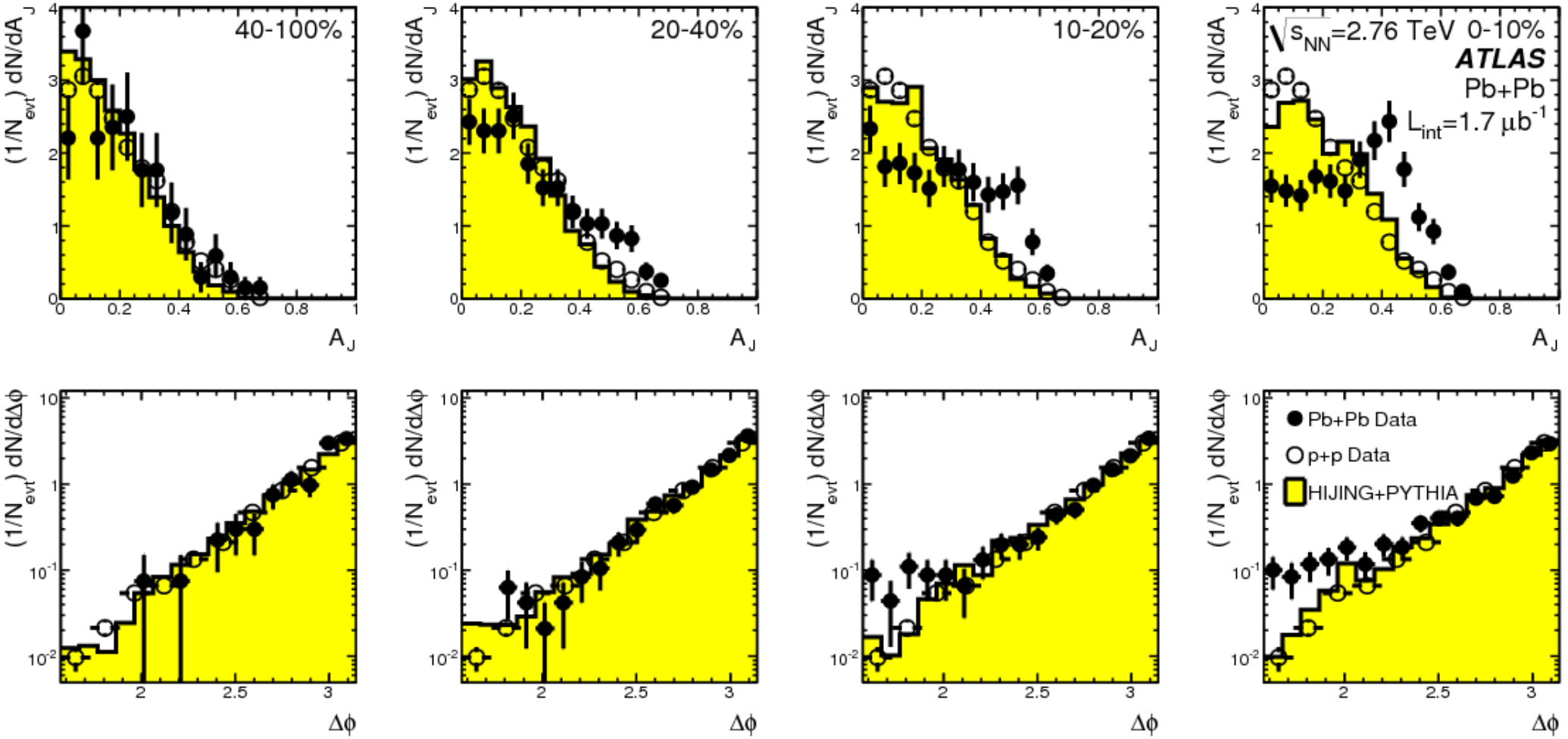
Phys Rev Lett
105, 252303



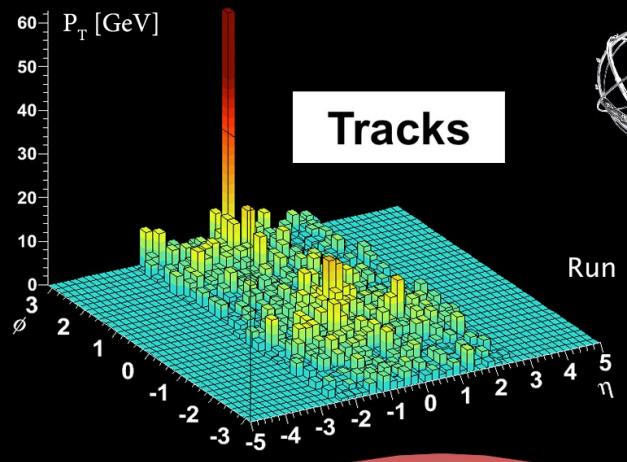
$$A_J = \frac{E_{T1} - E_{T2}}{E_{T1} + E_{T2}}$$

"Peripheral"

"Central"



An Asymmetric Dijet Event

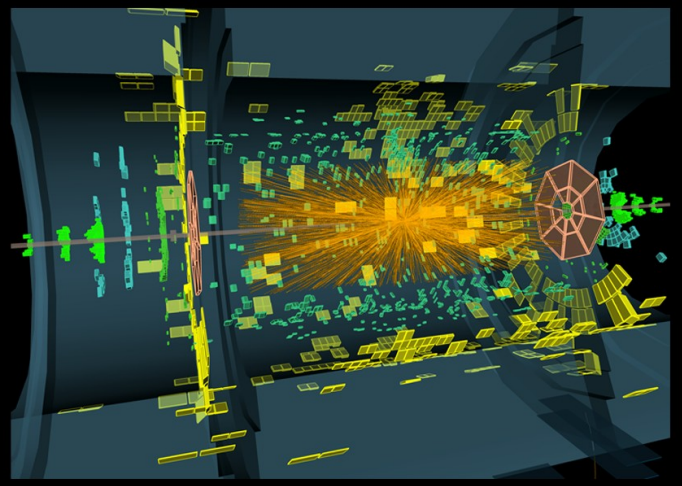


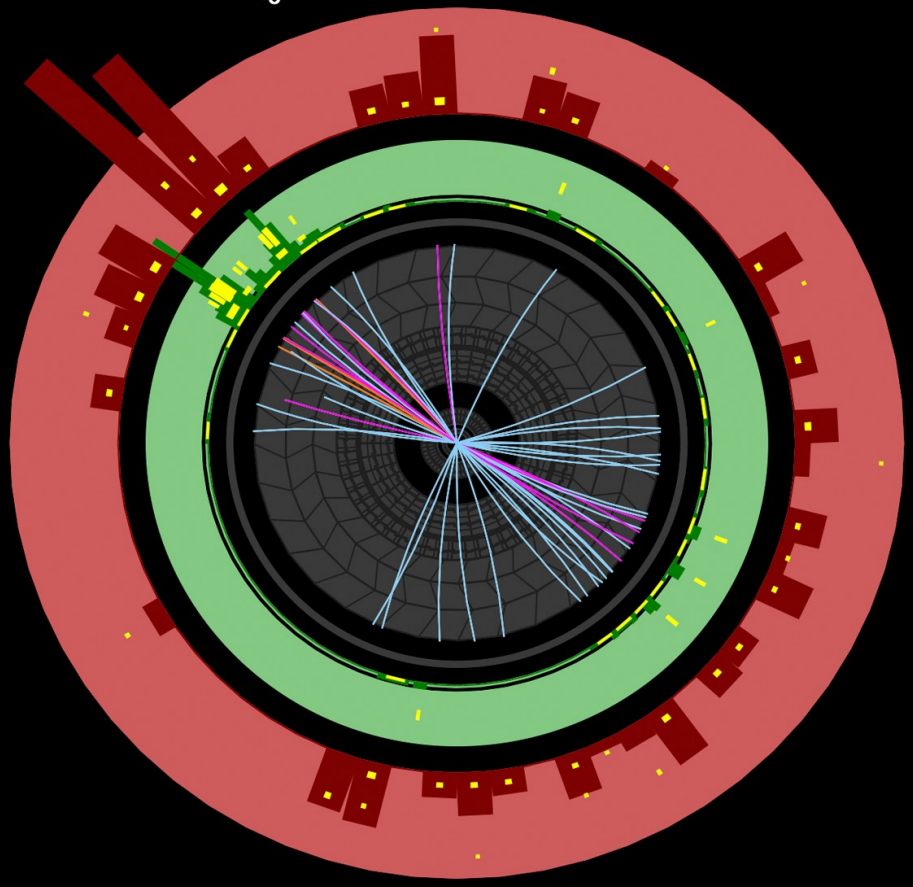
Tracks

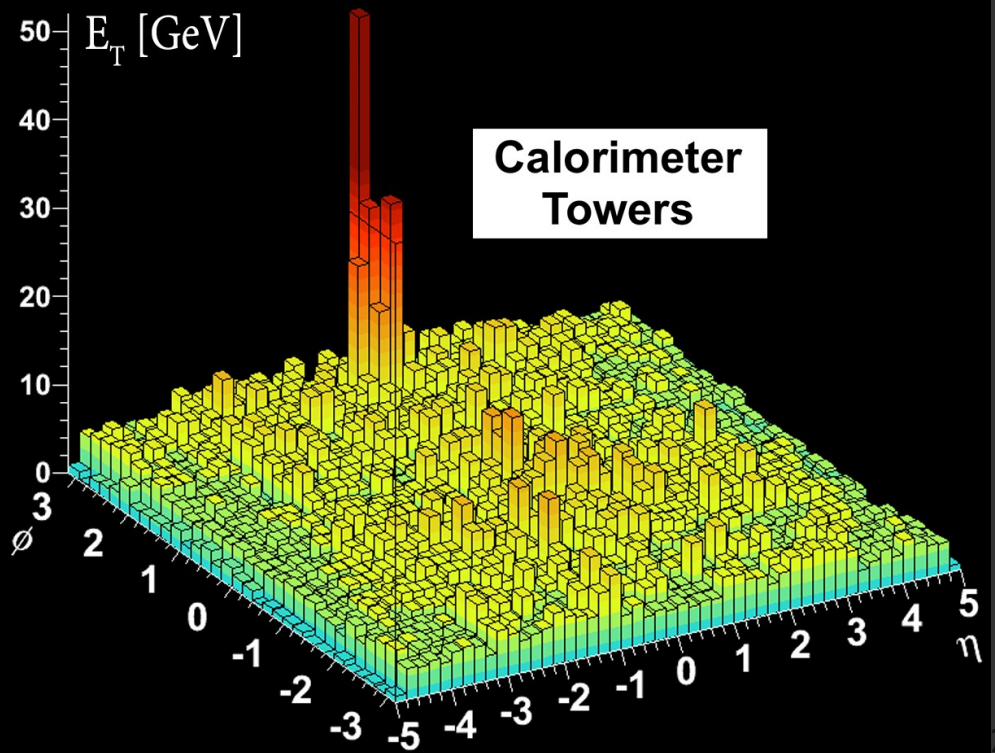
ATLAS EXPERIMENT

Run Number: 169045, Event Number: 1914004

Date: 2010-11-12 04:11:44 CET



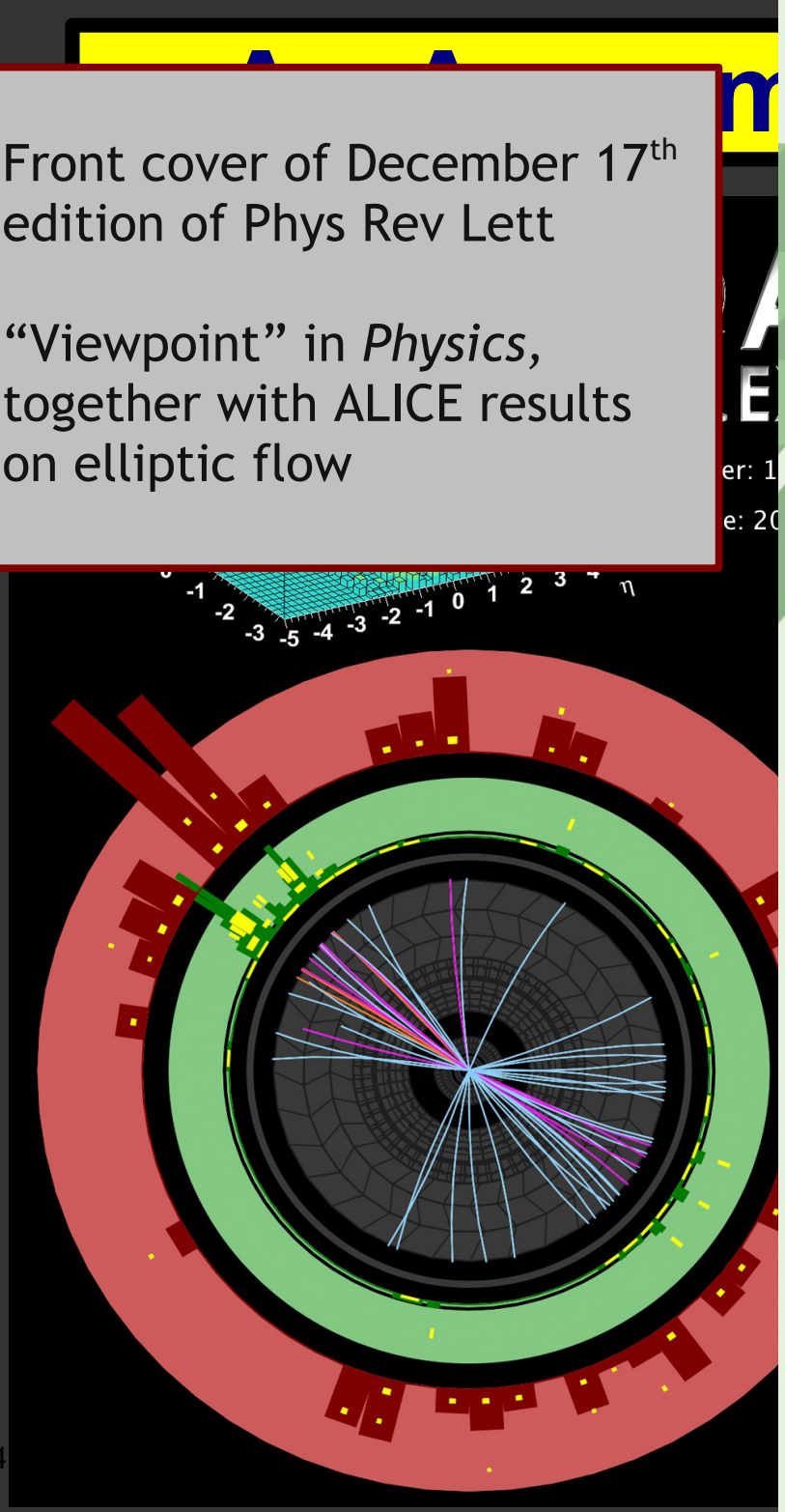




Calorimeter Towers

Front cover of December 17th edition of Phys Rev Lett

"Viewpoint" in *Physics*, together with ALICE results on elliptic flow



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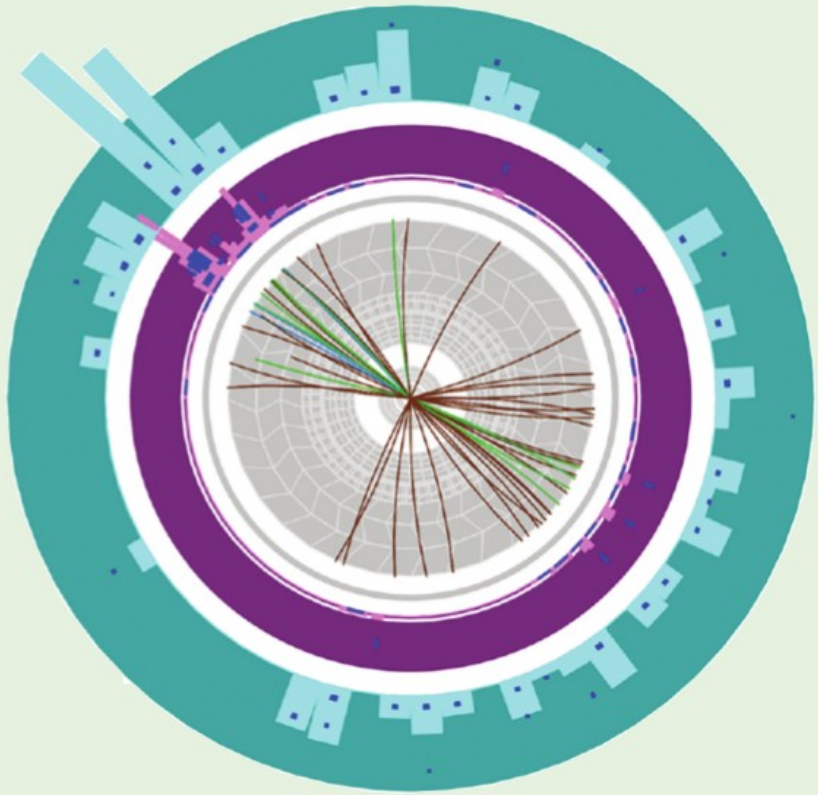


Published by the
American Physical Society

APS physics

Volume 105, Number 25

Isolated Photon Production

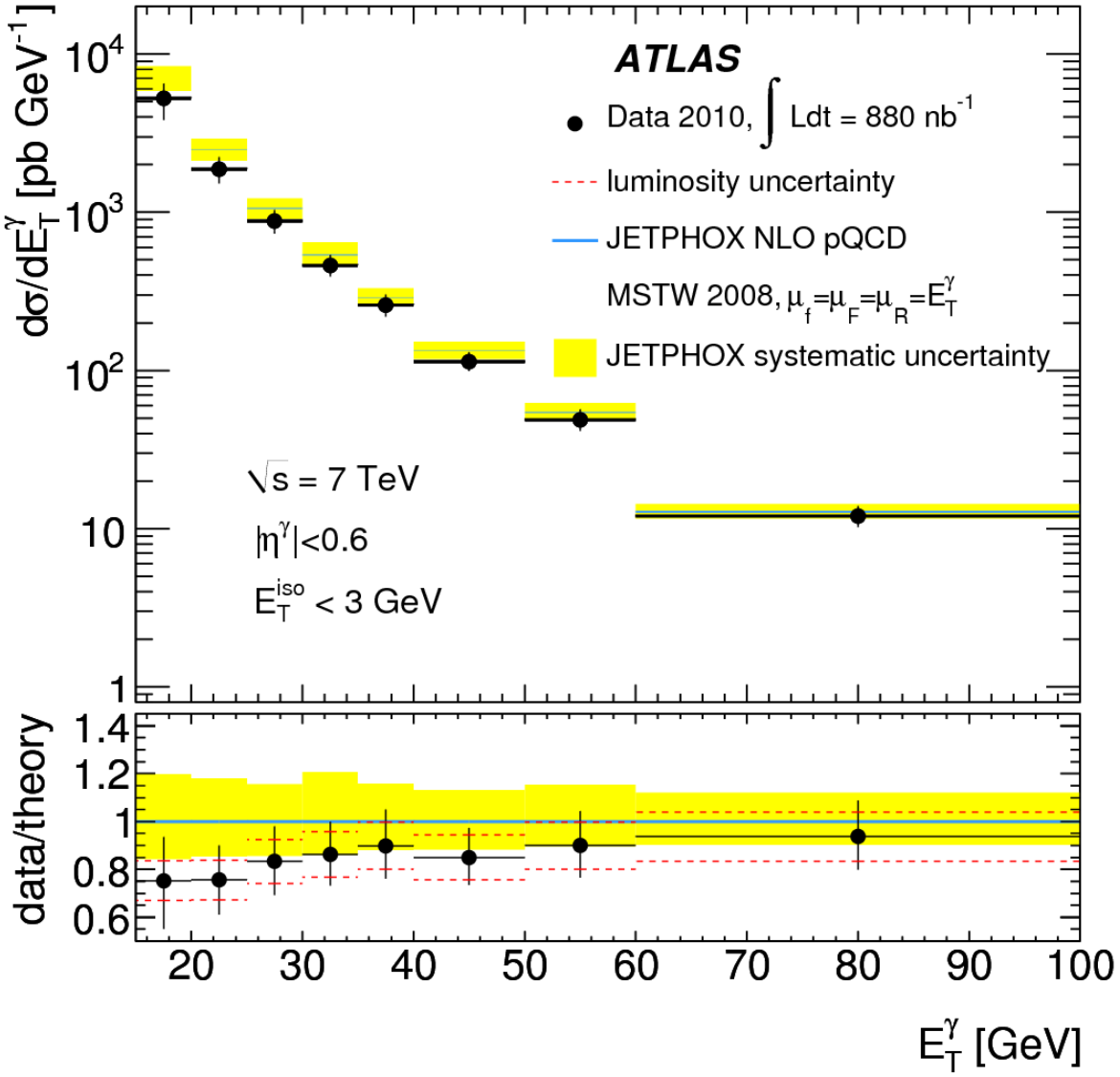
arXiv:1012.4272 (20 Dec 2010)

Isolated photons: p_T^γ>15 GeV
includes converted photons (~1/3rd)

Efficiencies from simulation, accounting for shower-shapes seen in data
QCD backgrounds estimated from data

Differential cross-sections measured in three $|\eta^\gamma|$ ranges

JETPHOX NLO predictions tend to overshoot data for p_T^γ<25 GeV in central η bins



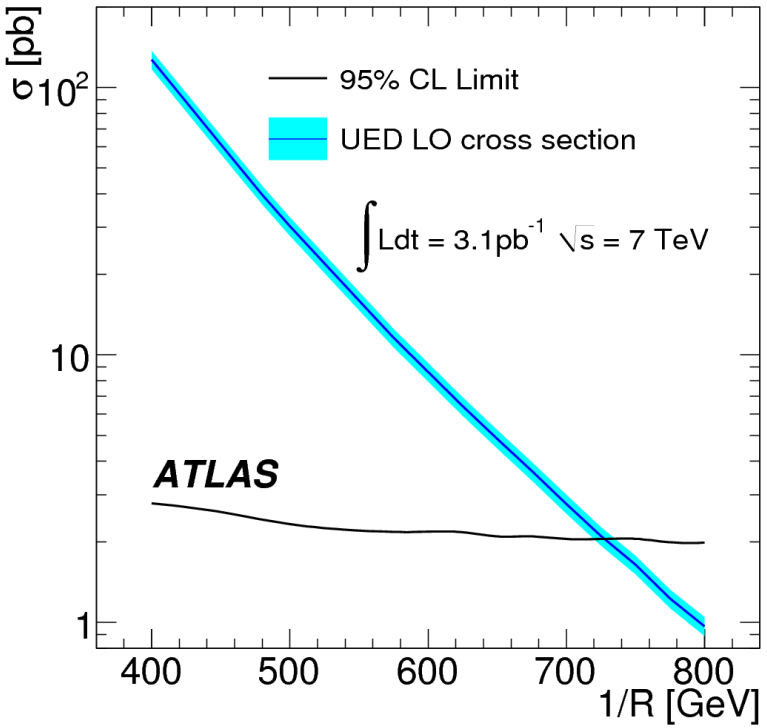
Search in γγ +E_T^{miss}

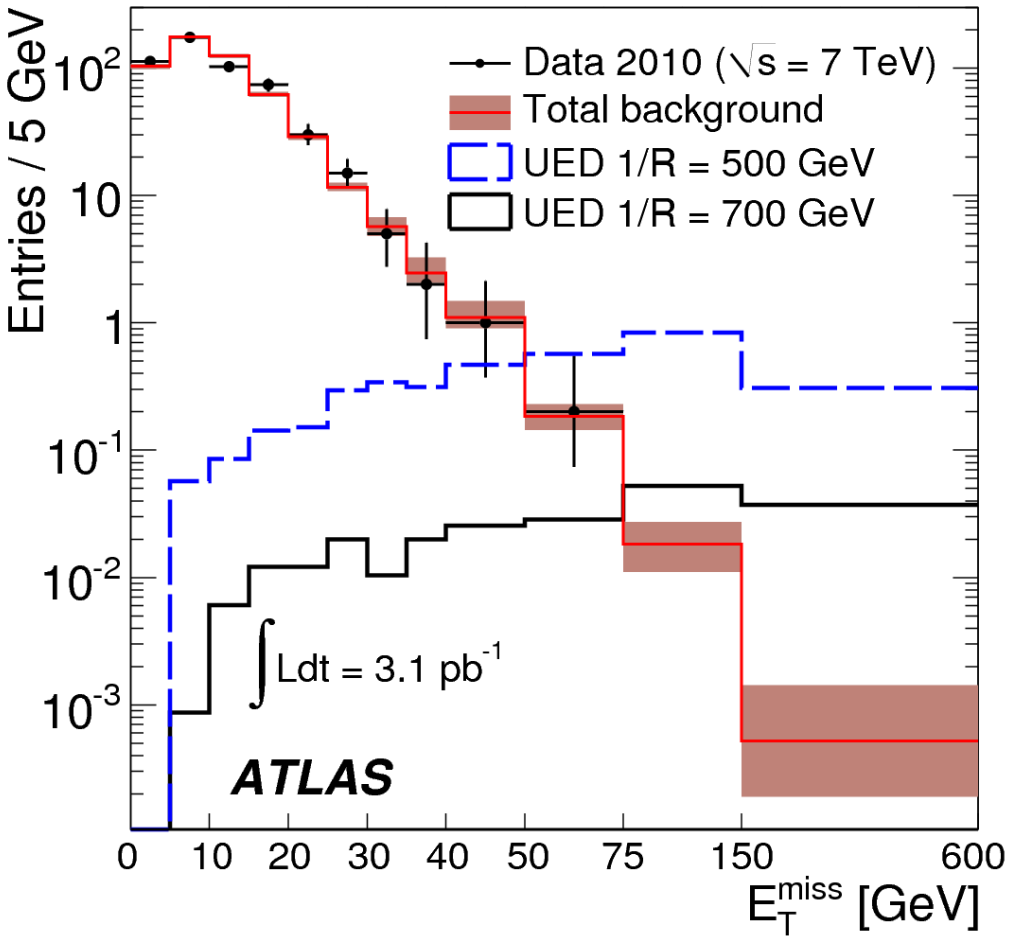
arXiv:1012.4272 (20 Dec 2010)

Search for unusual event signatures with two photons and missing E_T

Signal models have additional extra dimension ("UED"), scale parameter 1/R (setting ΛR=20)

Model implementation:
M. El Kacimi et al., Comput. Phys. Commun. 181, 122 (2010)



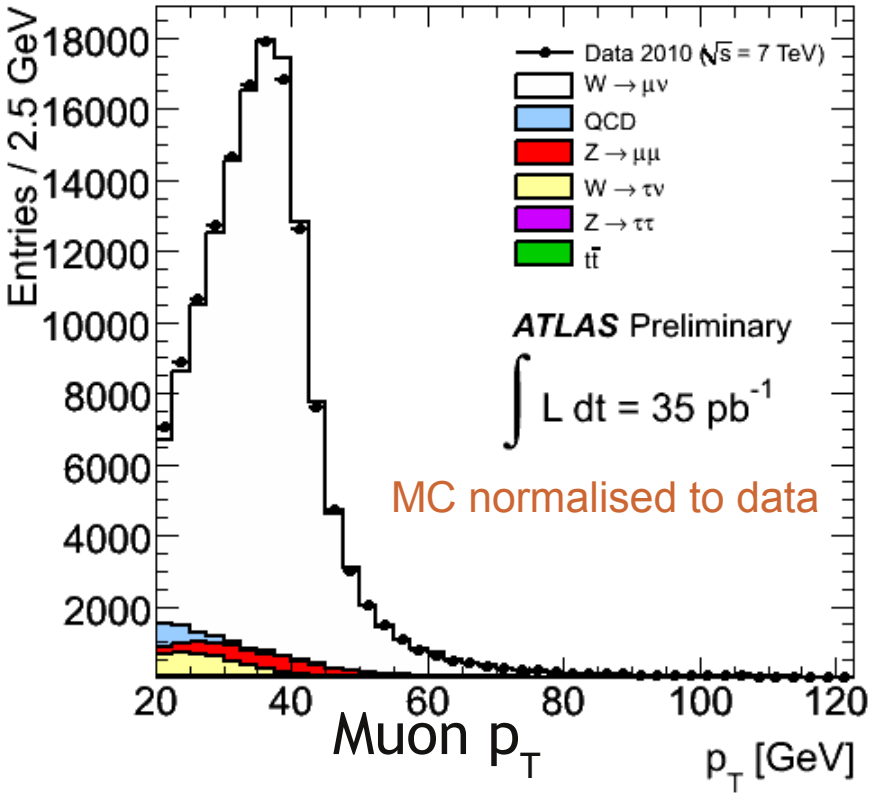


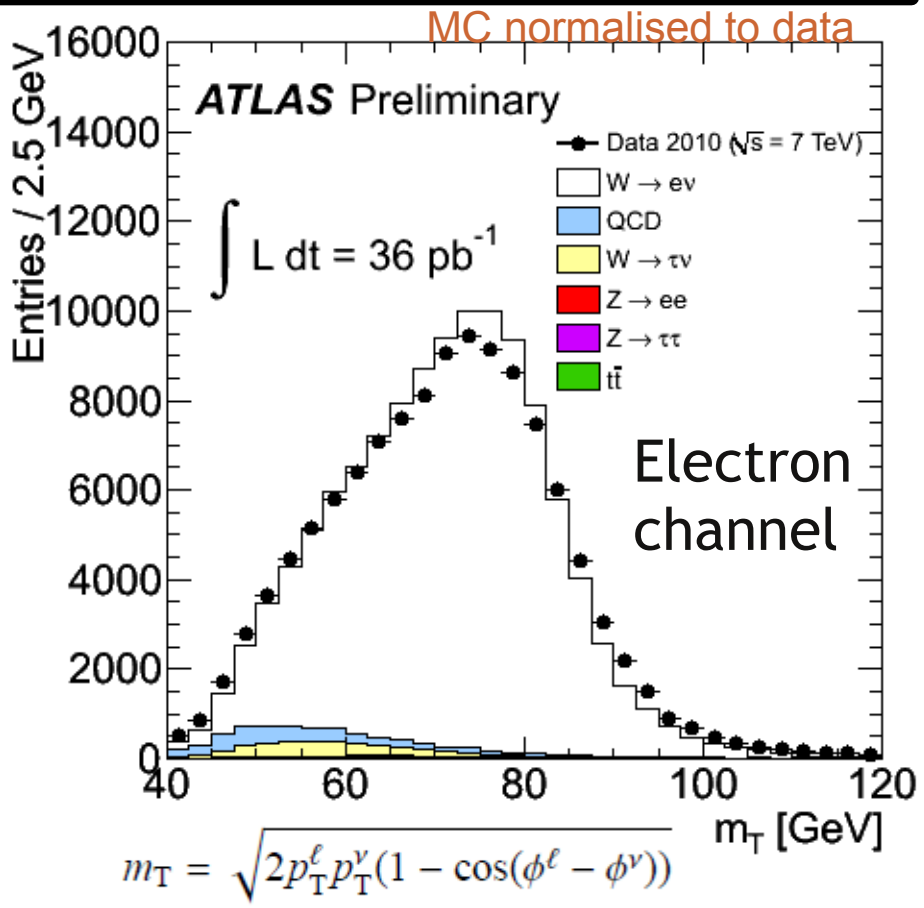
1/R > 728 GeV at 95% CL
(Cf. D0 limit 1/R > 477 GeV)

W Event Selection

Simple selection criteria, e.g.

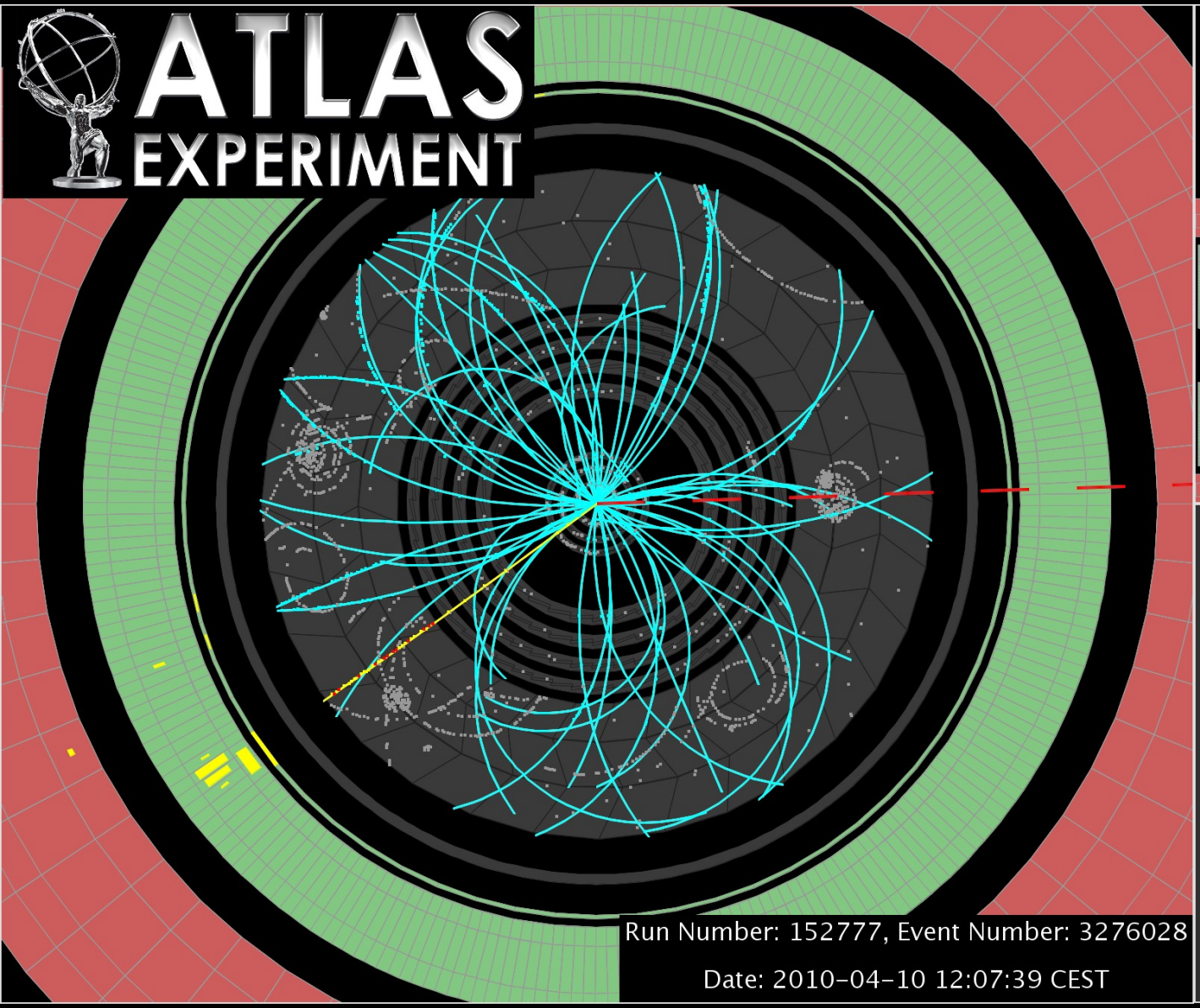
- electron ID: E_T>20 GeV |η|<2.5
- muon ID: p_T>20 GeV |η|<2.5, p_T match inner det-muon system
- veto second lepton (Z veto)
- E_T^{miss} > 25 GeV, M_T > 40 GeV



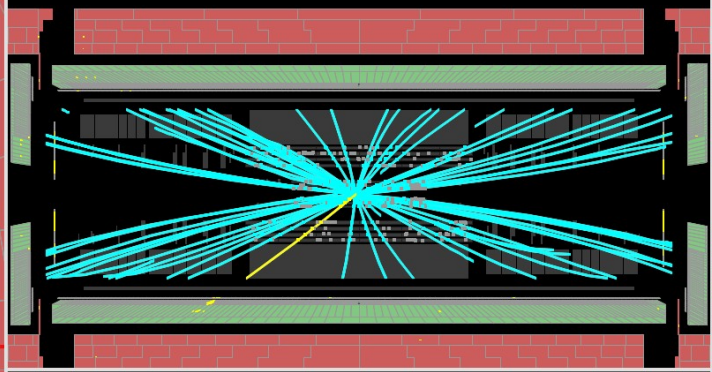


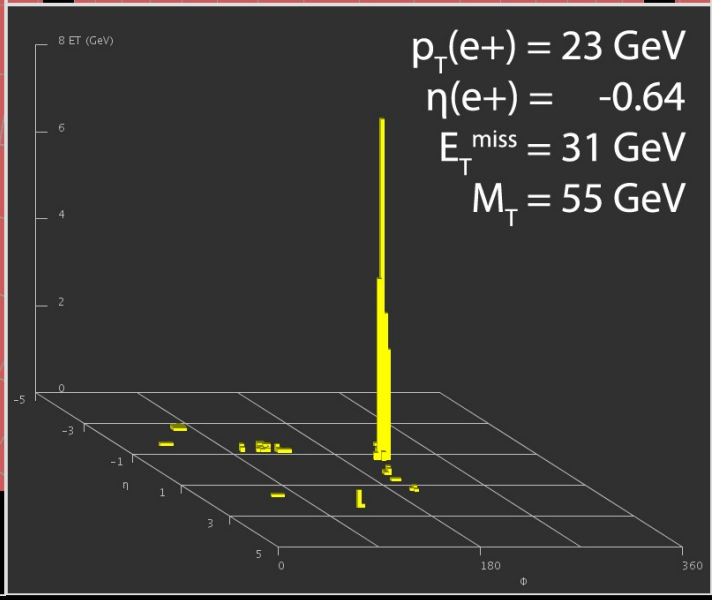
$$m_T = \sqrt{2p_T^{\ell}p_T^{\nu}(1-\cos(\phi^{\ell}-\phi^{\nu}))}$$

Clean well-understood signals: lepton ID and missing-E_T working rather well



W→eν candidate in 7 TeV collisions

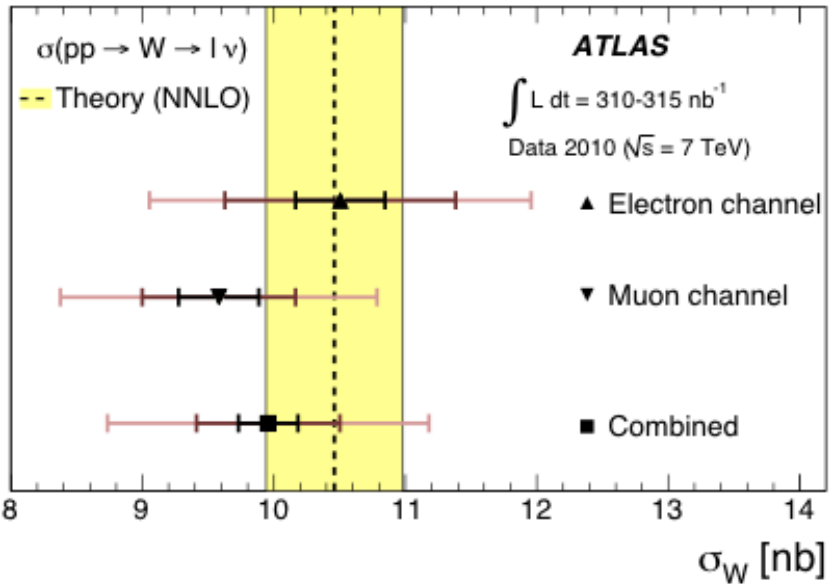


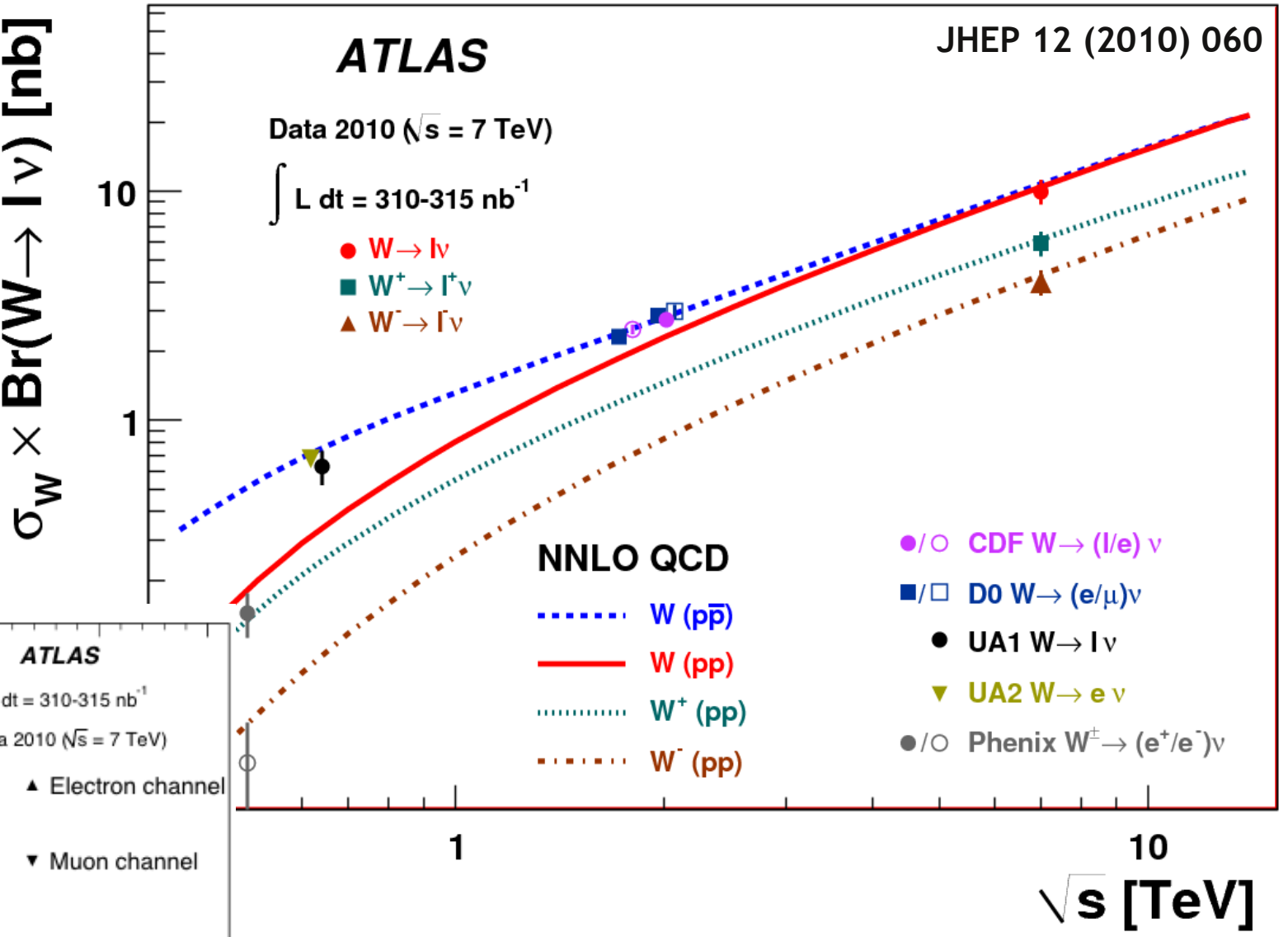


Dave Charlton, 26 January 2011

W Cross-Section

Error dominated by luminosity uncertainty of ±11%





W→τν

Observation of W→τν based on 0.5 pb^{-1}

→ 78 events with hadronic τ decay candidates

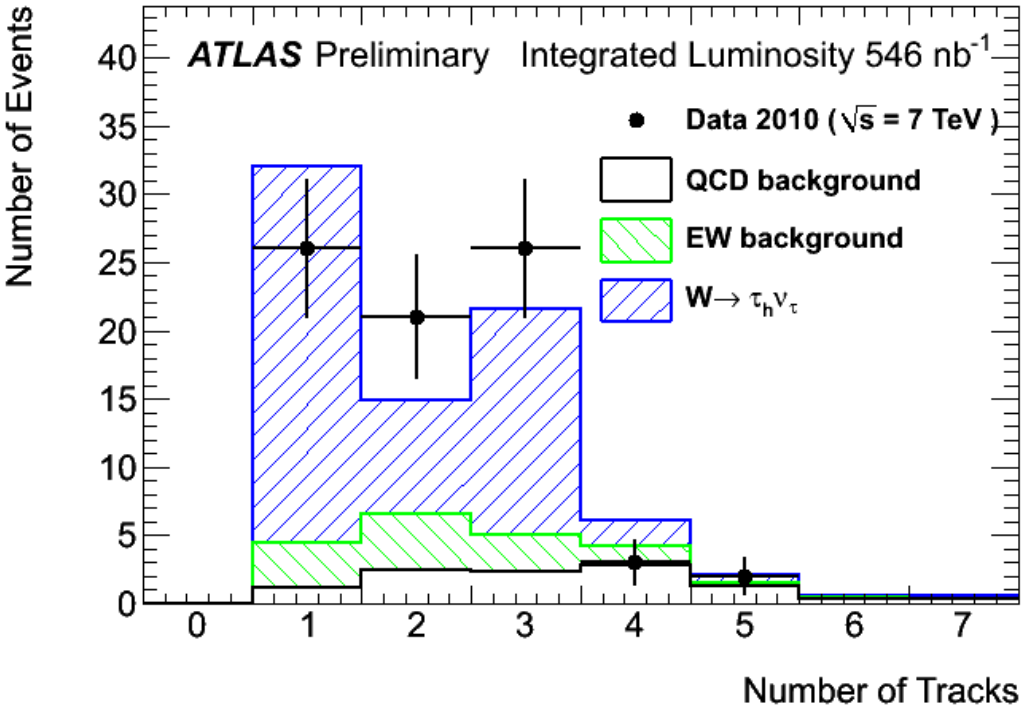
Backgrounds:

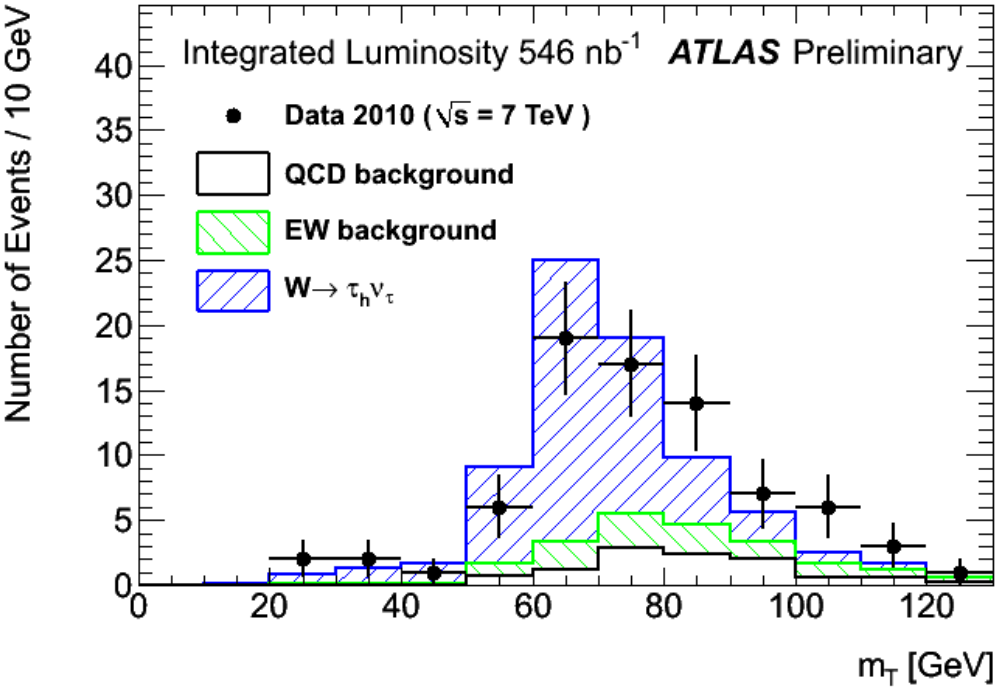
11.1±2.3±3.2 from QCD

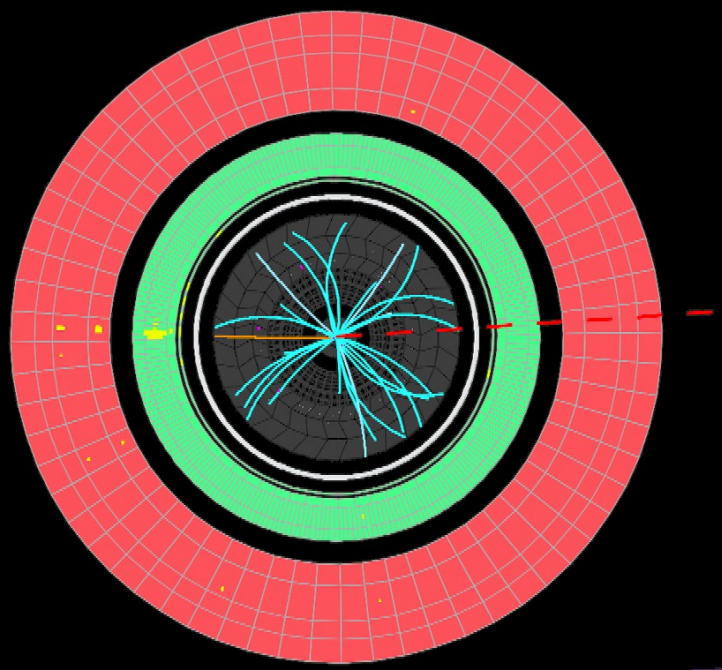
11.8±0.4±3.7 from other W/Z decays

Event properties consistent with expectation

→ Rachid Mazini talk



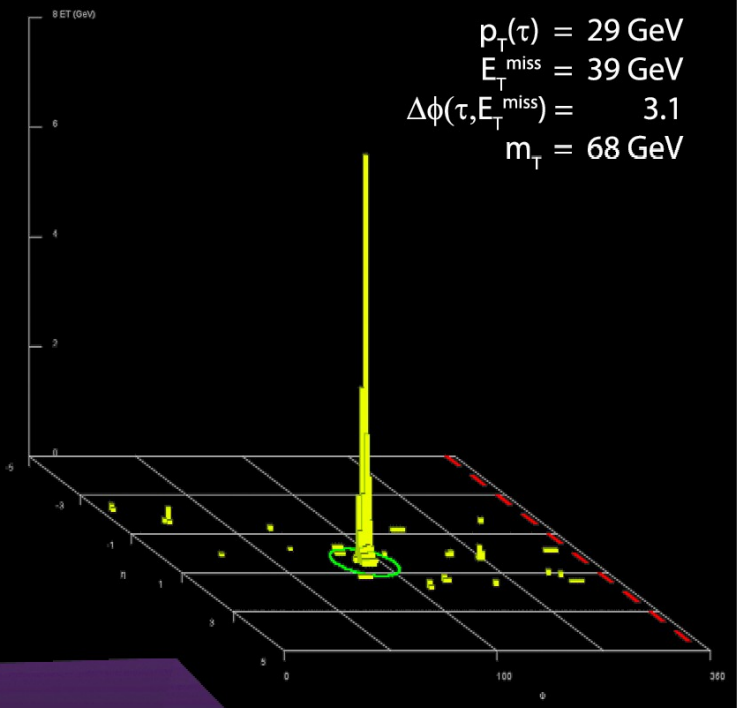




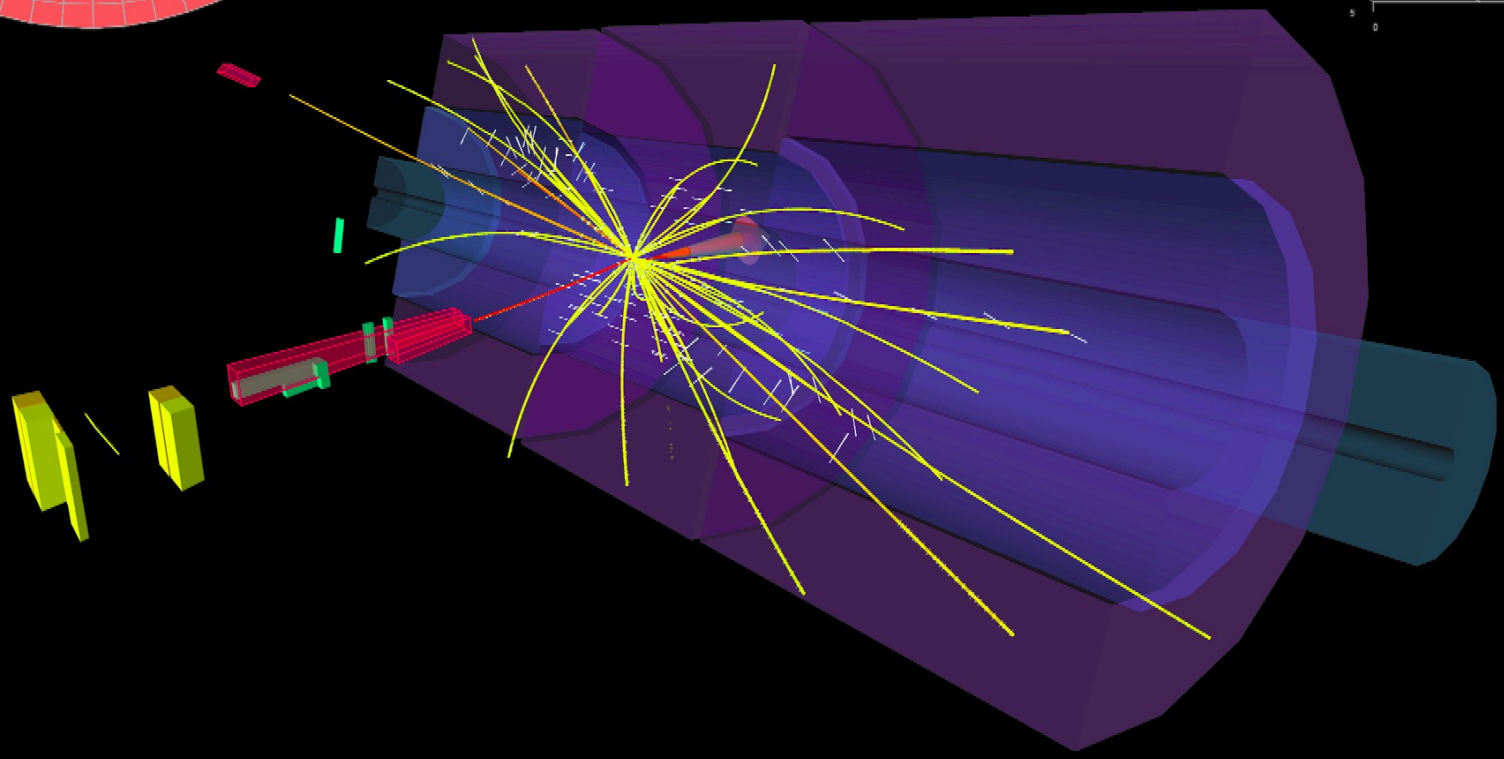
ATLAS EXPERIMENT

Run 155697, Event 6769403
Time 2010-05-24, 17:38 CEST

$W \rightarrow \tau\nu$ candidate in
7 TeV collisions



$p_T(\tau)$ = 29 GeV
E_T^{miss} = 39 GeV
$\Delta\phi(\tau, E_T^{miss})$ = 3.1
m_T = 68 GeV

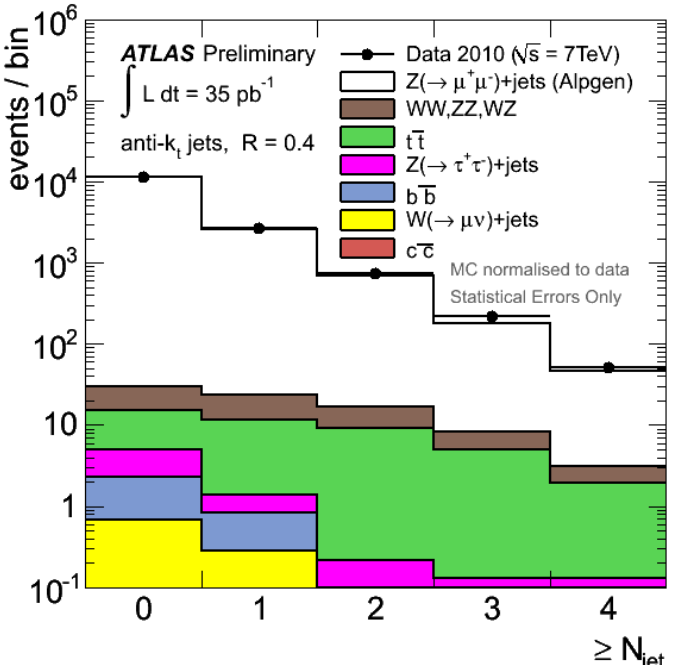


(W or Z) +jets

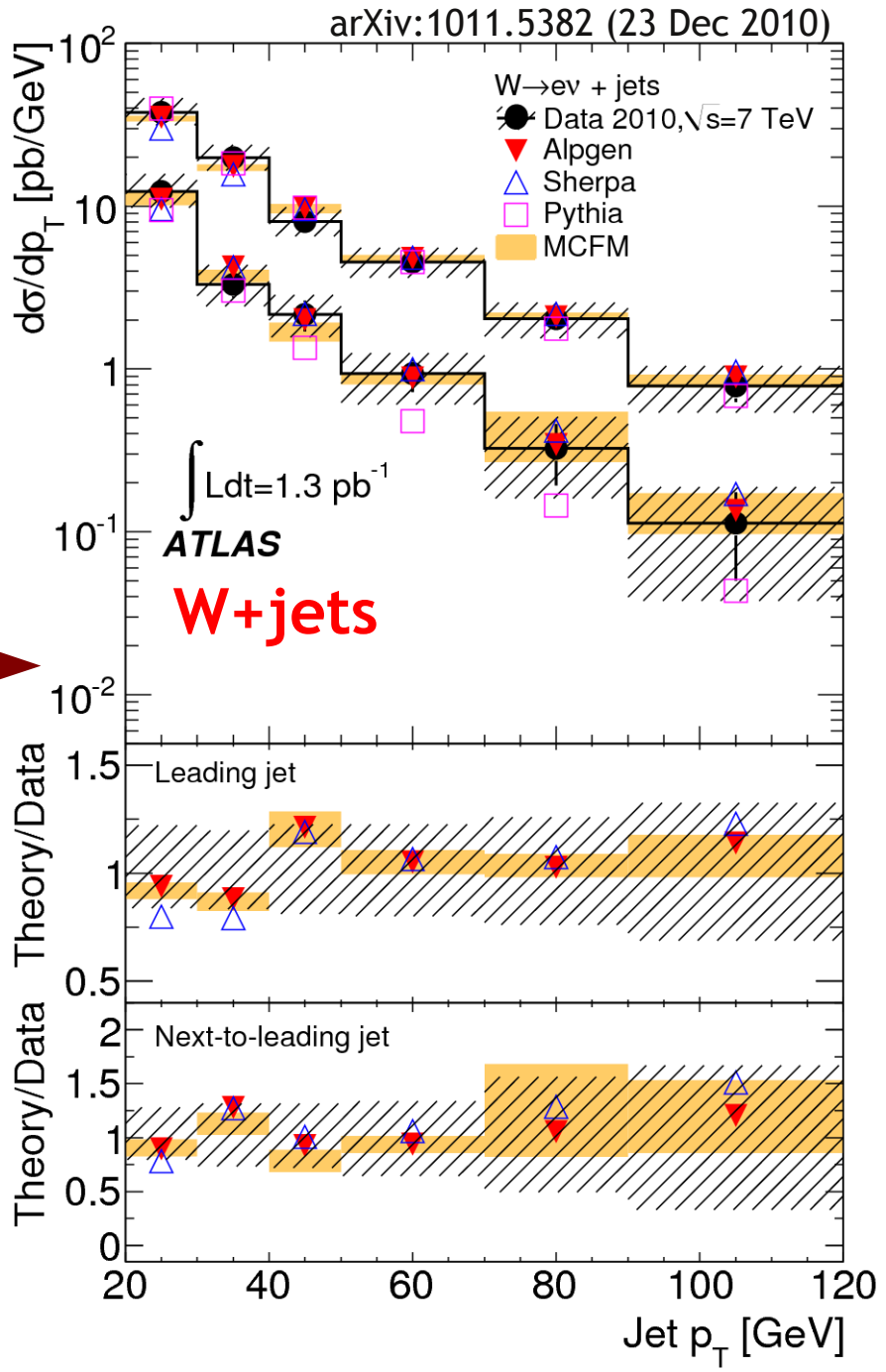
Powerful test of QCD corrections – and a milestone for many new physics searches

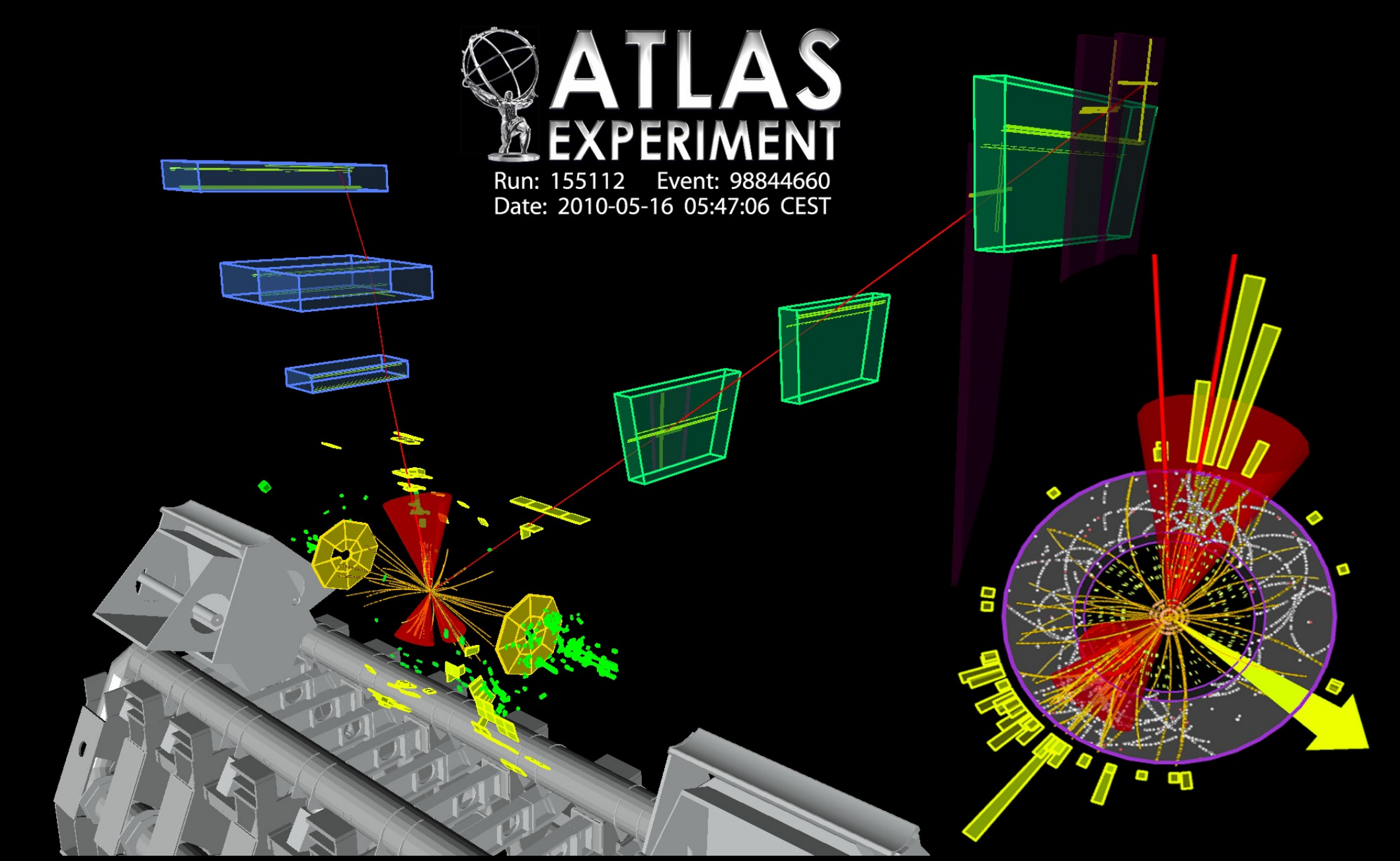
Leading and next-to-leading jet p_T spectra measured for W→(e/μ)ν

W+jets data well described by Alpgen and Sherpa MC models, but not by Pythia



Z+jets
(uncorrected)





W→μν candidate with 3 jets with E_T>40 GeV

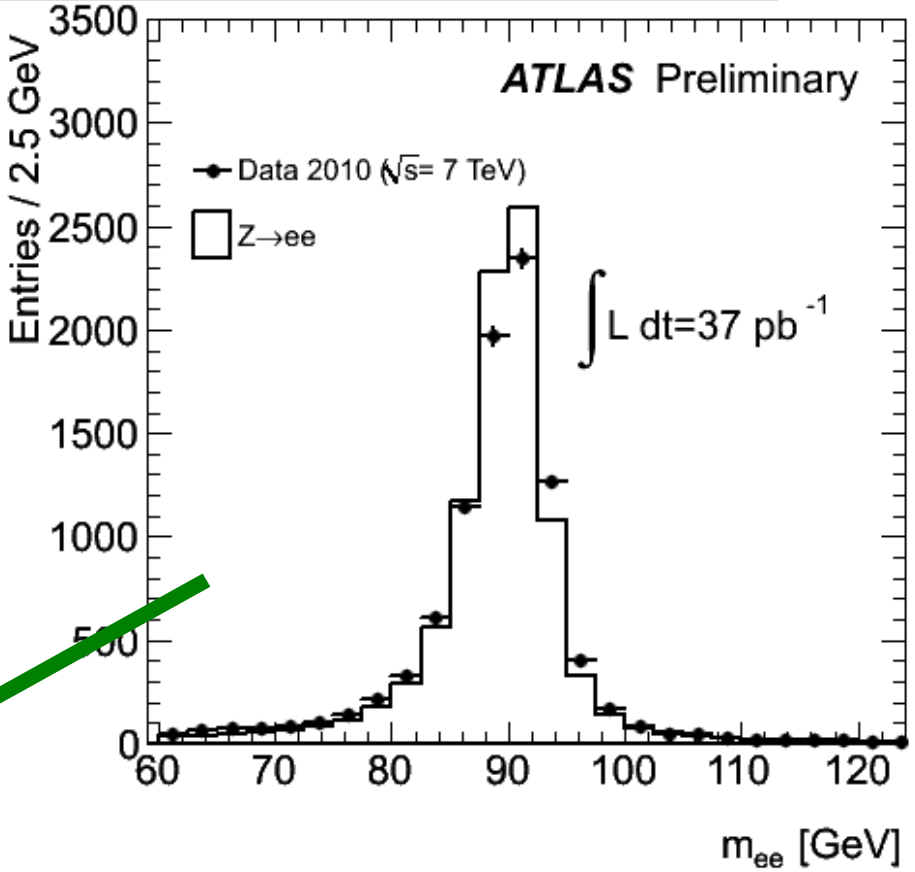
Second muon reconstructed in the highest E_T jet

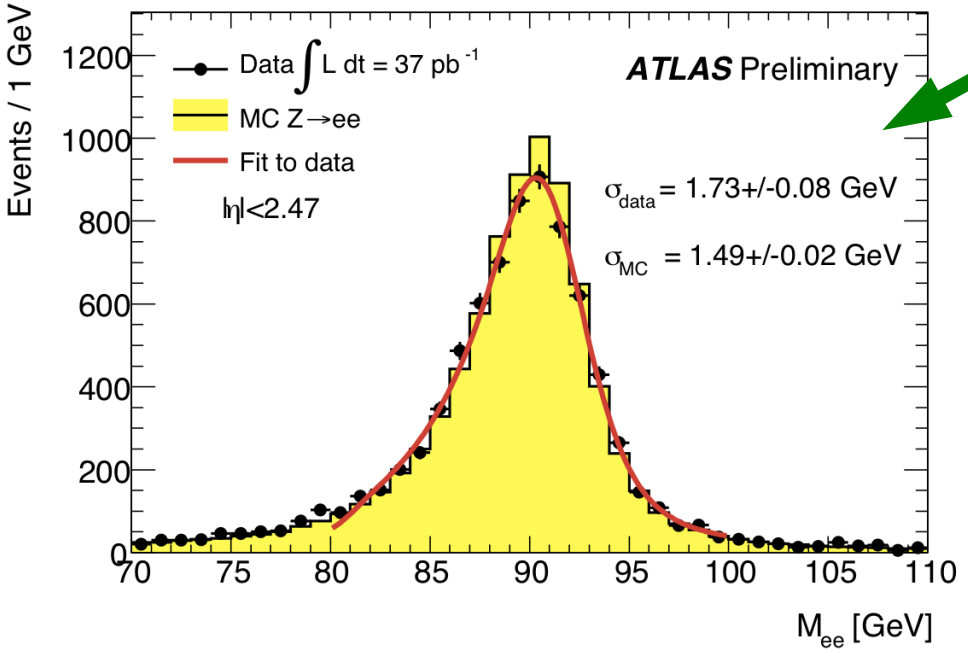
Z Selection

Simple selection:

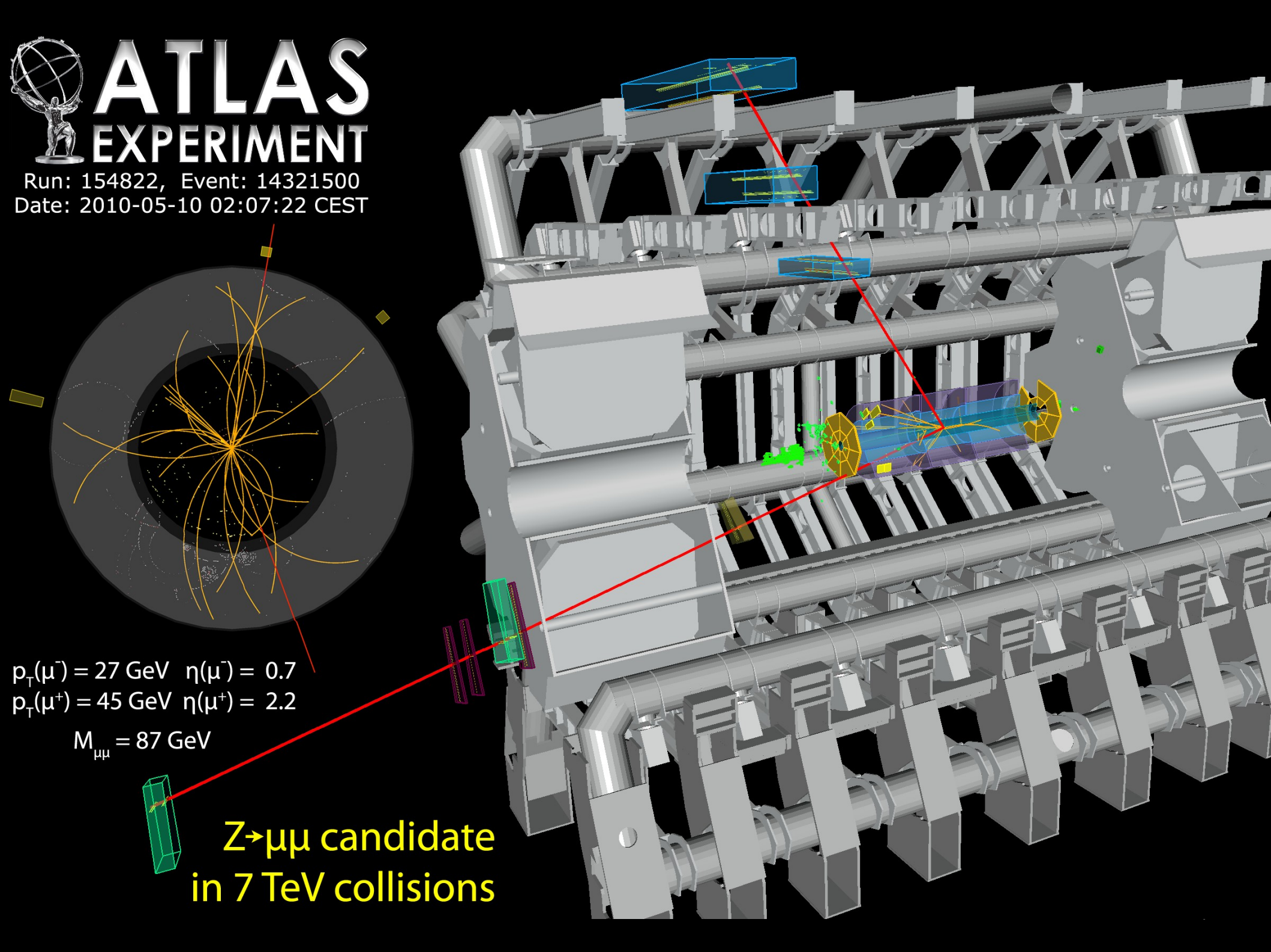
- $p_T(\ell) > 20$ GeV
- two like-flavour opposite charge leptons
- $66 < m_{\ell\ell} < 116$ GeV

Statistics now allow increasingly detailed calorimeter inter-calibration (ee) and inner detector/muon system alignment (μμ)

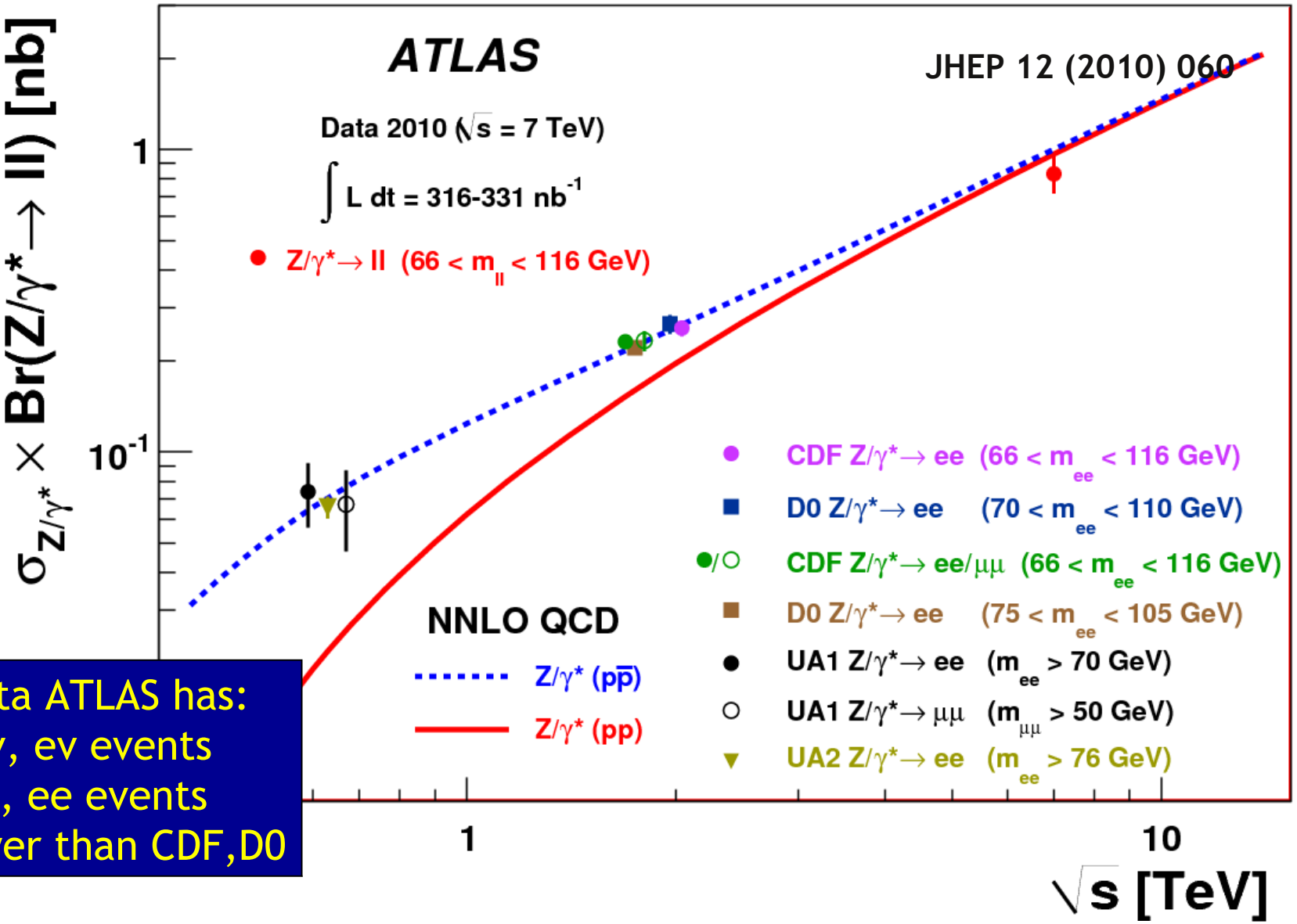




Example shown in ee channel – reconstructed Z mass peak from first-pass reco (above) and after relative calibration of 28 regions of the EM calorimeter (left) – corrections ~2% consistent with expected precision

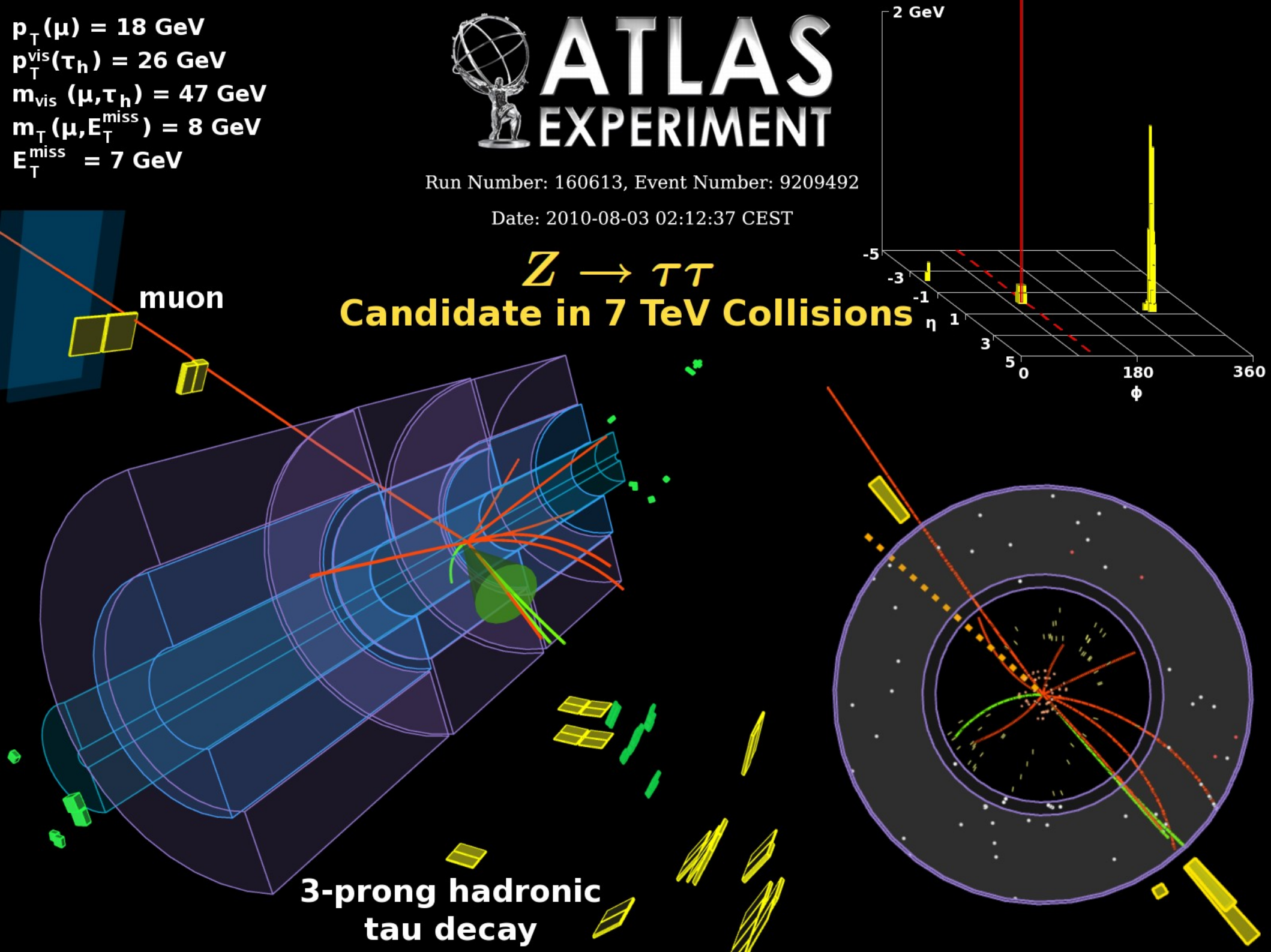

ATLAS
EXPERIMENT
Run: 154822, Event: 14321500
Date: 2010-05-10 02:07:22 CEST
$p_T(\mu^-) = 27$ GeV $\eta(\mu^-) = 0.7$
$p_T(\mu^+) = 45$ GeV $\eta(\mu^+) = 2.2$
$M_{\mu\mu} = 87$ GeV
Z→μμ candidate
in 7 TeV collisions

Z Cross-Section



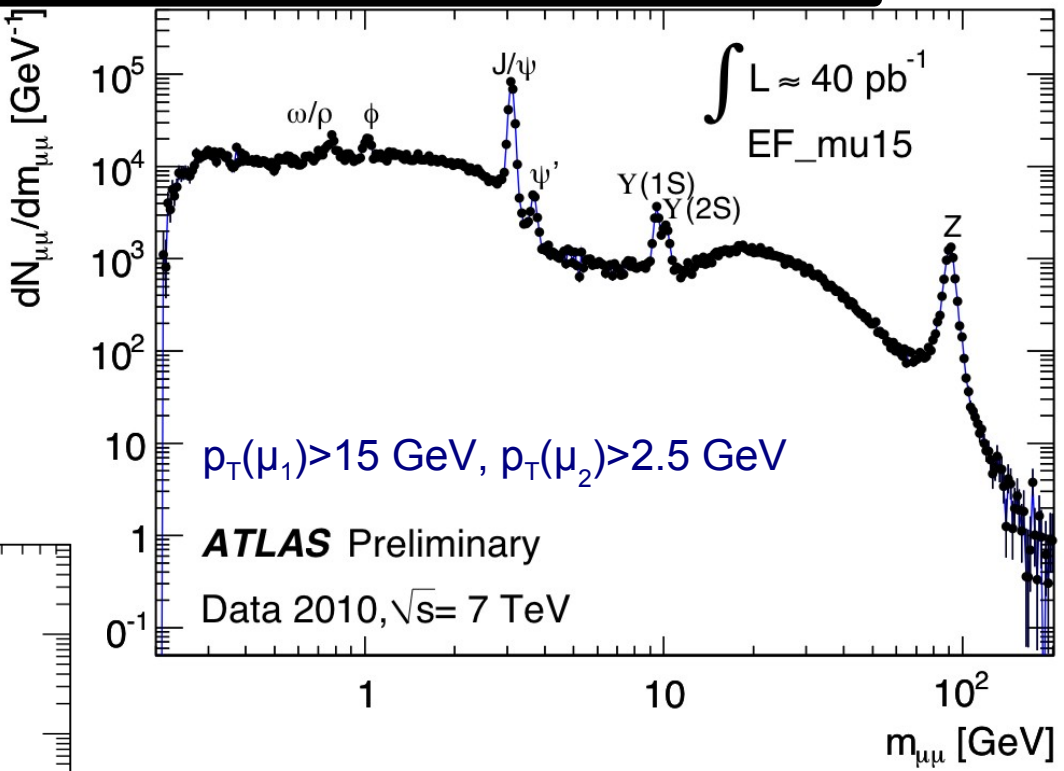
In the 2010 data ATLAS has:
- ~ 250k W → μν, eν events
- ~ 23k Z → μμ, ee events
- ~ 50 times fewer than CDF,D0

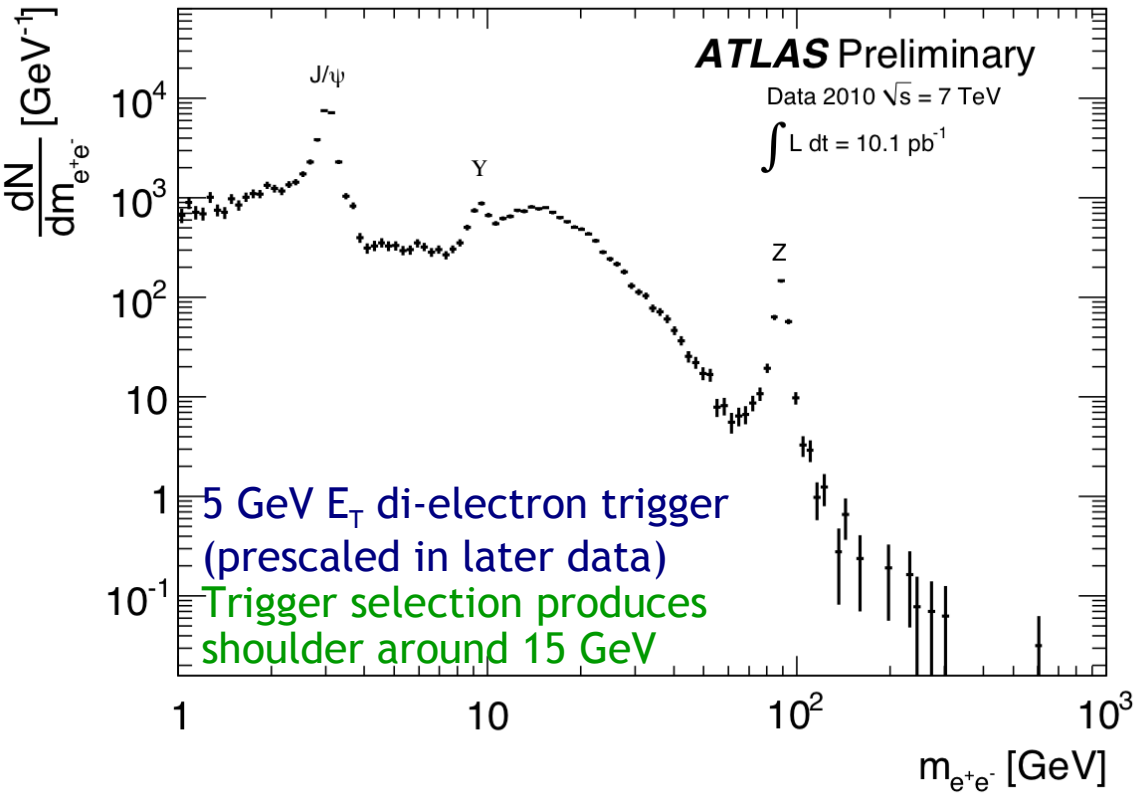
$$\sigma^{tot}_{Z/\gamma^*} \cdot BR(Z/\gamma^* \to \ell\ell) = 0.82 \pm 0.06(stat) \pm 0.05(syst) \pm 0.09(lumi)\ nb$$
$$(66 < m_{\ell\ell} < 116\ GeV)$$


$p_T(\mu)$ = 18 GeV
$p_T^{vis}(\tau_h)$ = 26 GeV
m_{vis} (μ,τ_h) = 47 GeV
$m_T(\mu,E_T^{miss})$ = 8 GeV
E_T^{miss} = 7 GeV
ATLAS EXPERIMENT
Run Number: 160613, Event Number: 9209492
Date: 2010-08-03 02:12:37 CEST
$Z \rightarrow \tau\tau$
Candidate in 7 TeV Collisions
2 GeV
-5
-3
-1
η
1
3
5
0
180
360
ϕ
muon
3-prong hadronic
tau decay

Dilepton Mass Spectra

Sensitive to a much wider range than the Z...





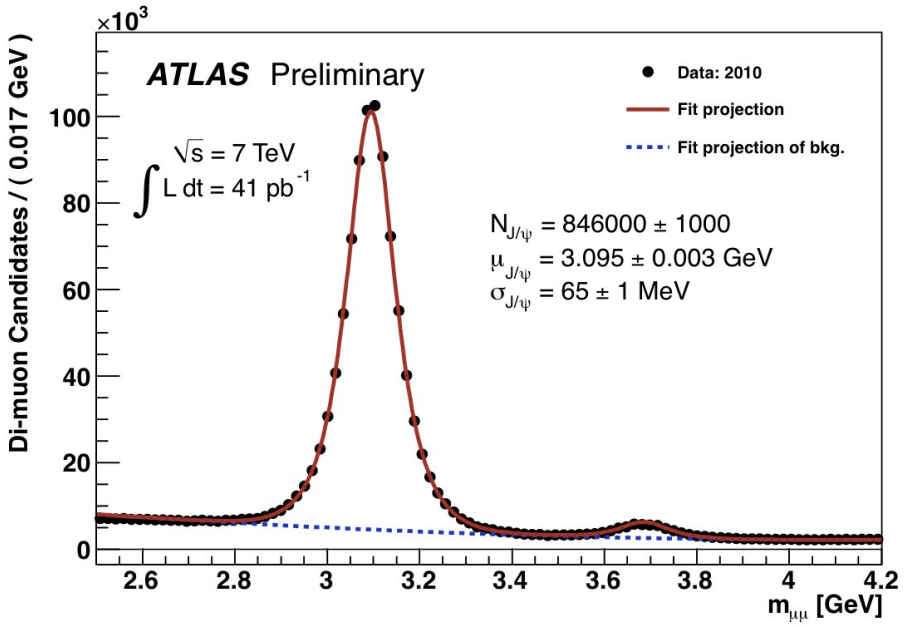
J/ψ and Υ region – b physics

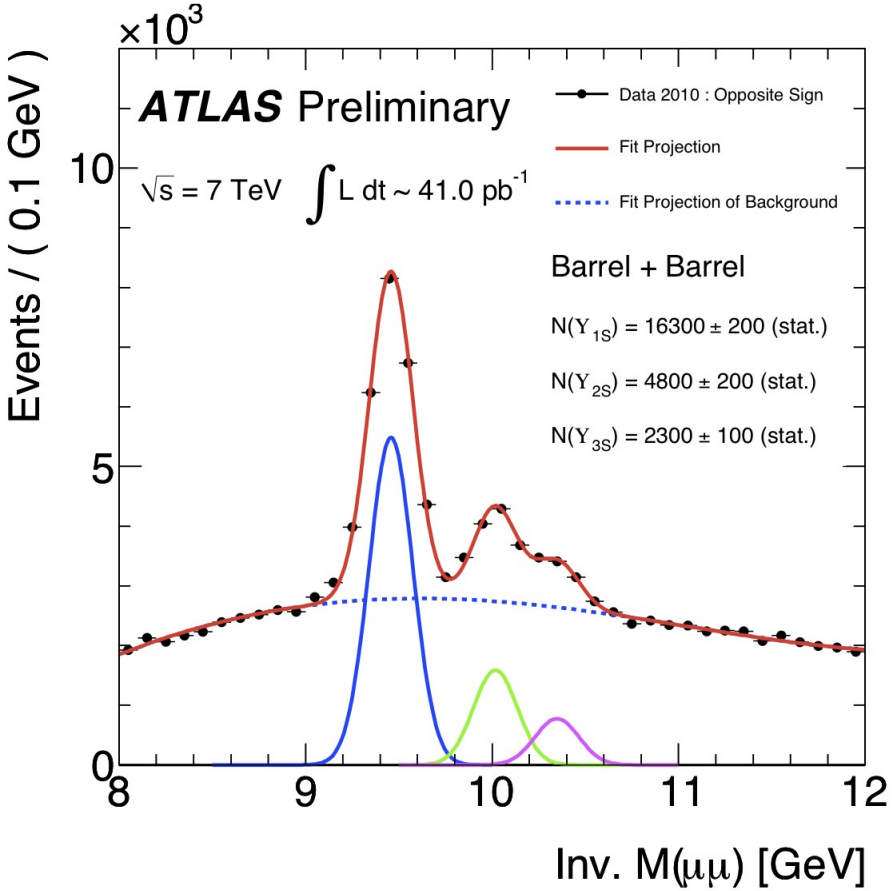
High mass region – Z' searches

J/ψ, ψ(2S) and ϒ→μμ

Use a selection of looser triggers
Oppositely charged muons with $p_T(\mu_1,\mu_2)>(2.5,4)$ GeV

For J/ψ, ψ(2S) refit tracks to a common vertex





About 60k ϒ(1S,2S,3S) candidates over full acceptance

$B \rightarrow J/\psi(\mu\mu)K^{\pm}$

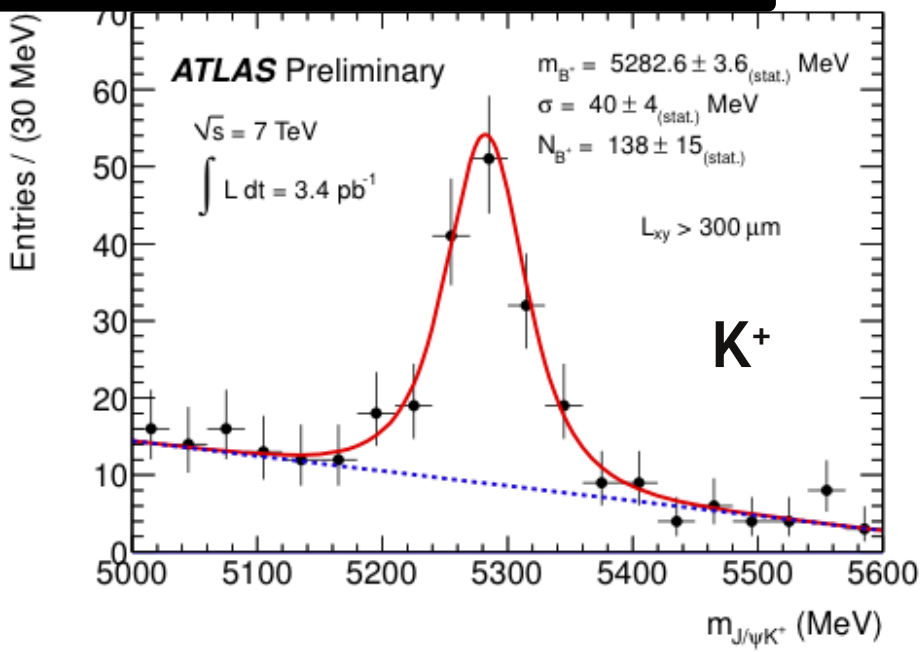
Signal for $B^{\pm} \rightarrow J/\psi(\mu\mu)K^{\pm}$

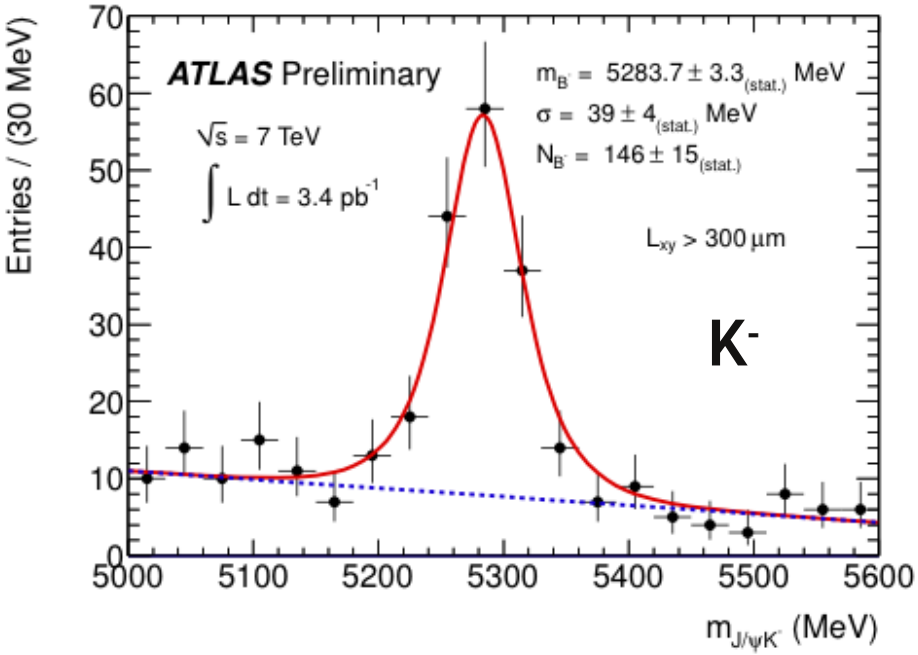
Require transverse decay length >300μm

Unbinned likelihood fit to signal (with event-by-event mass uncertainty) and linear background

Combining K^+ and K^-
- 283±22 signal events,
- fitted mass 5283±2.5 MeV

Cf PDG: 5279 MeV



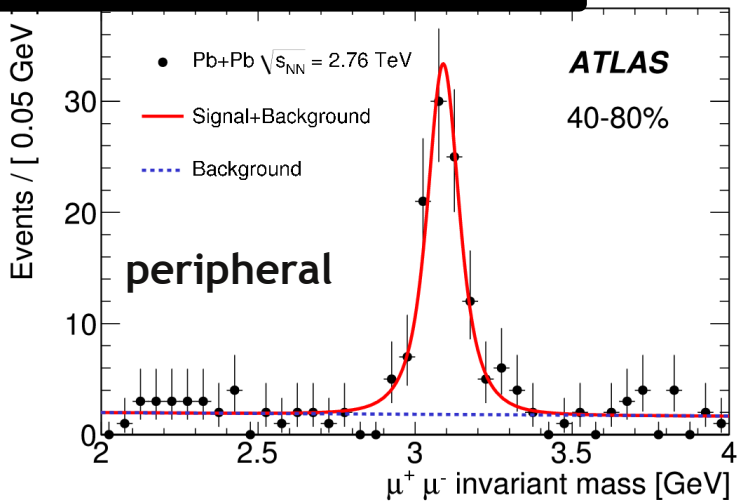


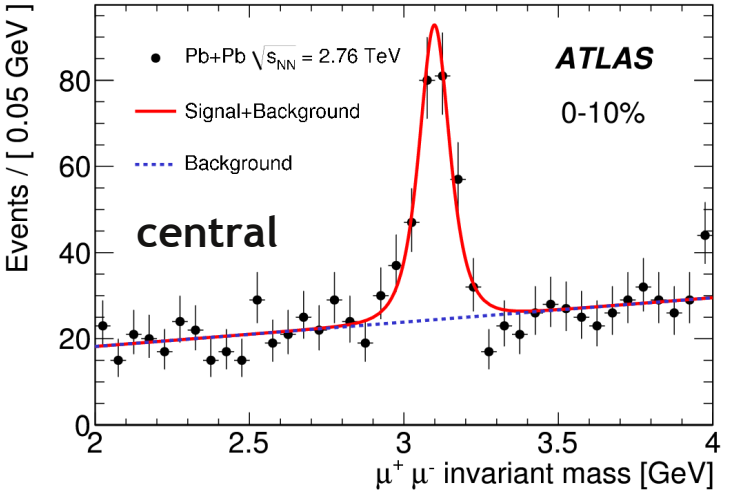
J/ψ→μμ in Heavy Ions

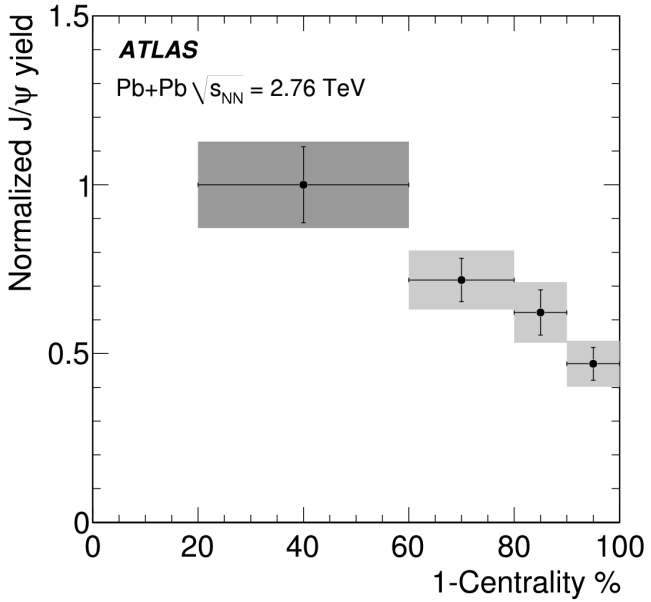
Production of quarkonium states in heavy ion collisions can be affected by if a hot dense medium is produced – e.g. by colour screening

J/ψ→μμ production measured as a function of collision centrality

Yields normalised by number of binary nucleon-nucleon collisions N_{coll}, taken from a Glauber model used at RHIC







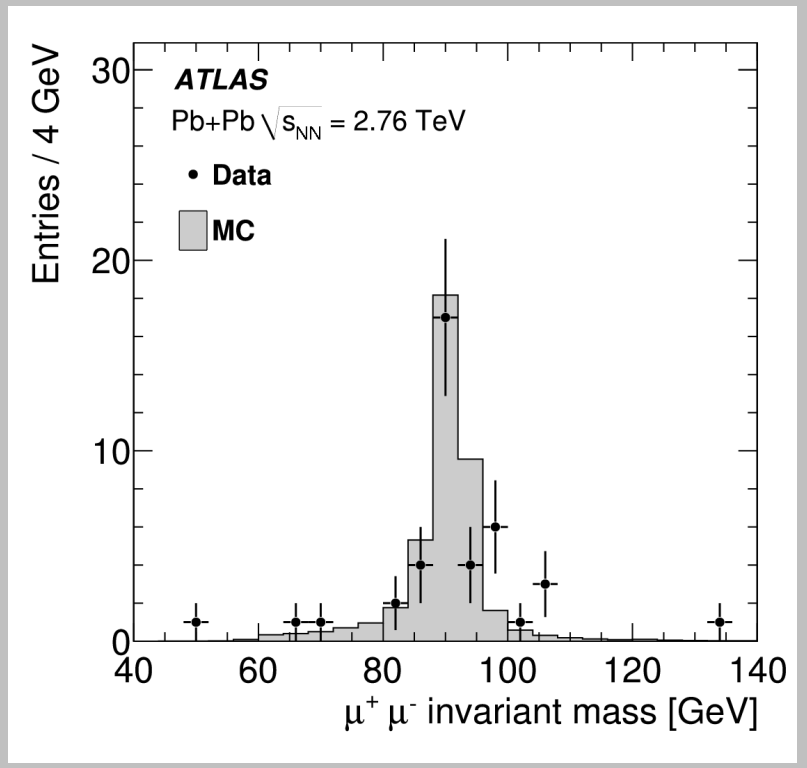
arXiv:1012.5419 (24 Dec 2010)

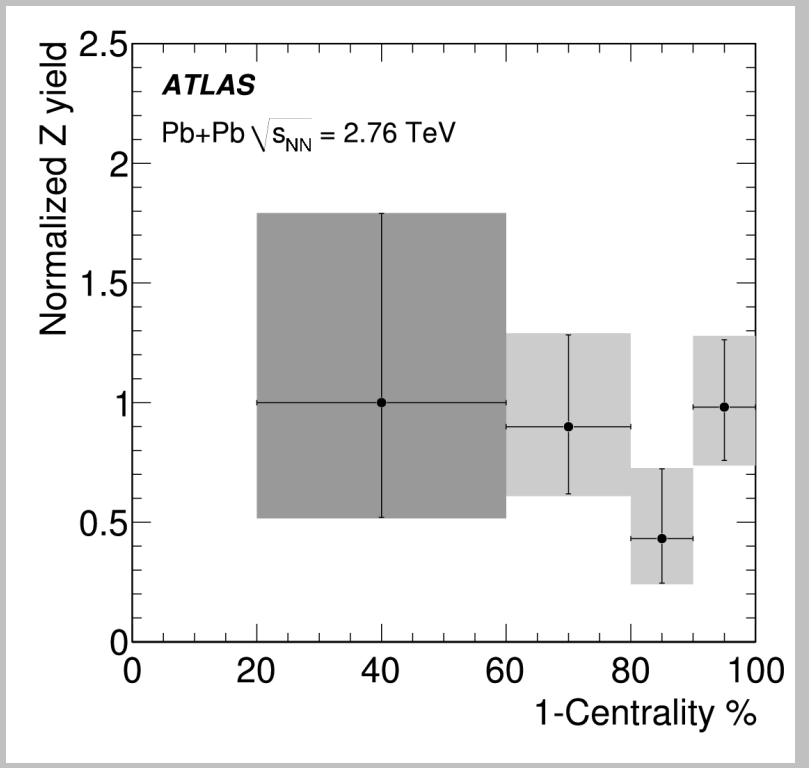
Effect seen, similar to that observed at RHIC

$\sqrt{s_{NN}}$=2.76 TeV instead of 0.2 TeV

J/ψ→μμ in Heavy Ions

Also looked at Z→μμ in Heavy Ion collisions, but statistics insufficient, from 2010 HI data



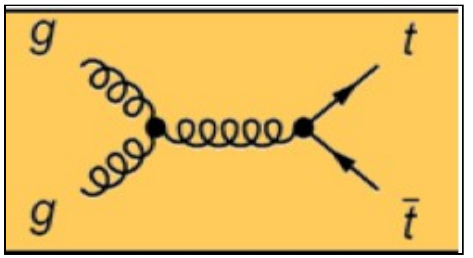


$\sqrt{s_{NN}}$=2.76 TeV instead of 0.2 TeV

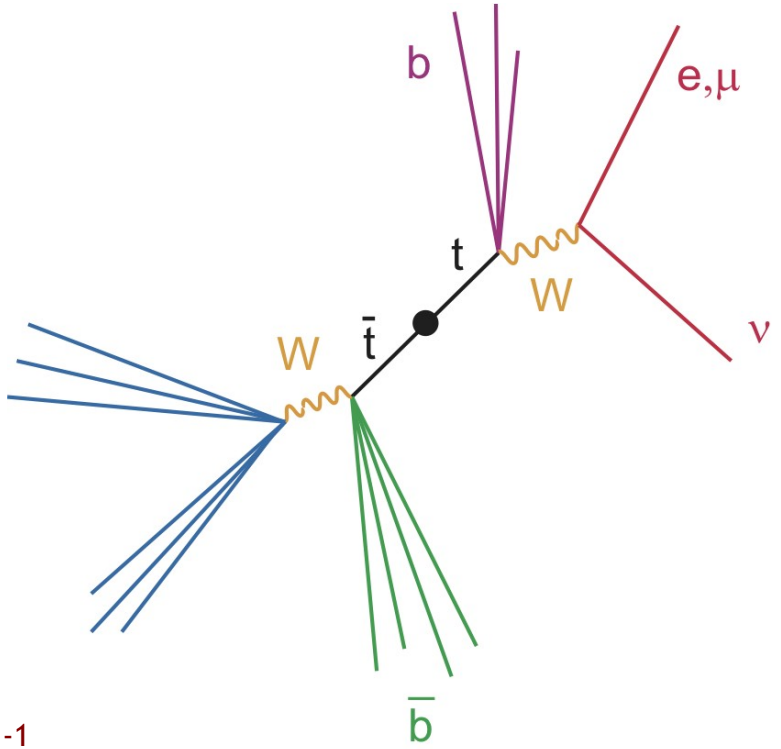
Top-Pair Production

Complete set of ingredients to allow to study production of ttbar:

e, μ, E_T^{miss}, jets, b-tag



Assume all tops decay to Wb: event topology then depends on the two W decays



Of interest:

lepton (e or μ),
E_T^{miss}, jjbb (37.9%)

dilepton (ee, μμ or eμ),
E_T^{miss}, bb (6.46%)

Data-driven methods to control QCD and W+jets backgrounds

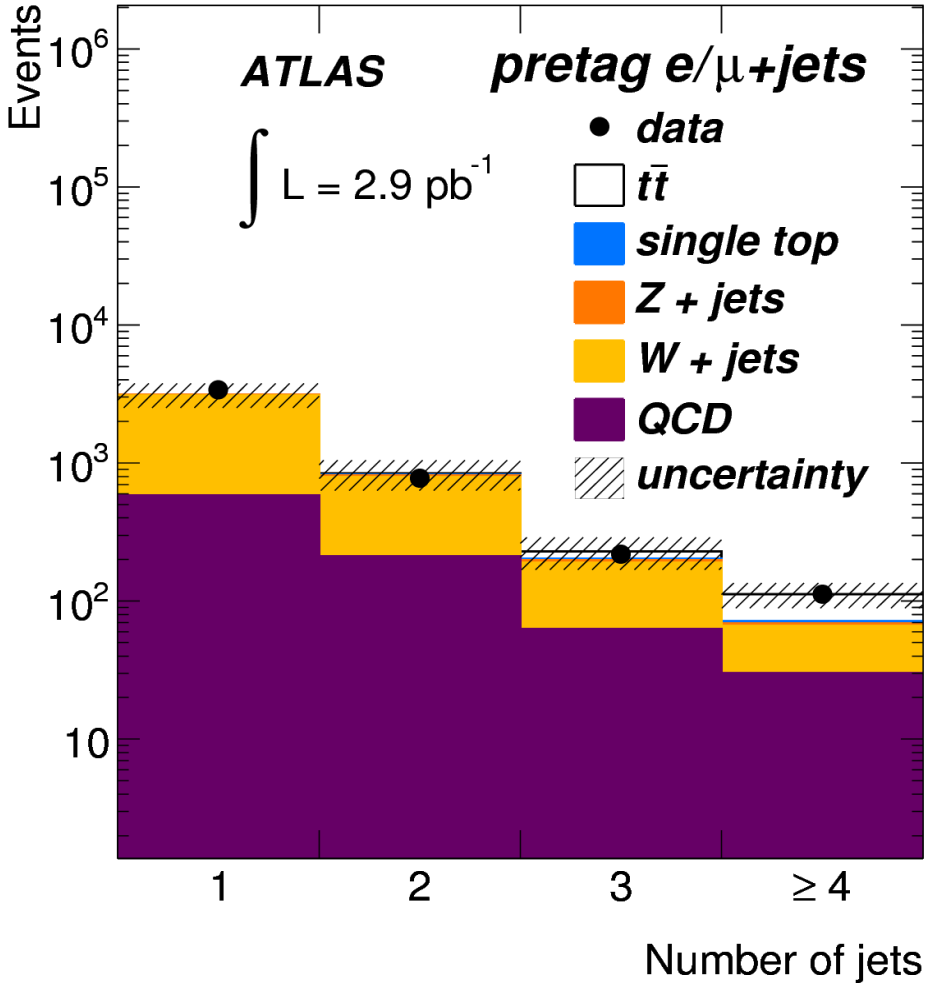
Cross-section measurement published with 2.9 pb^{-1}, some plots updated with full 2010 statistics

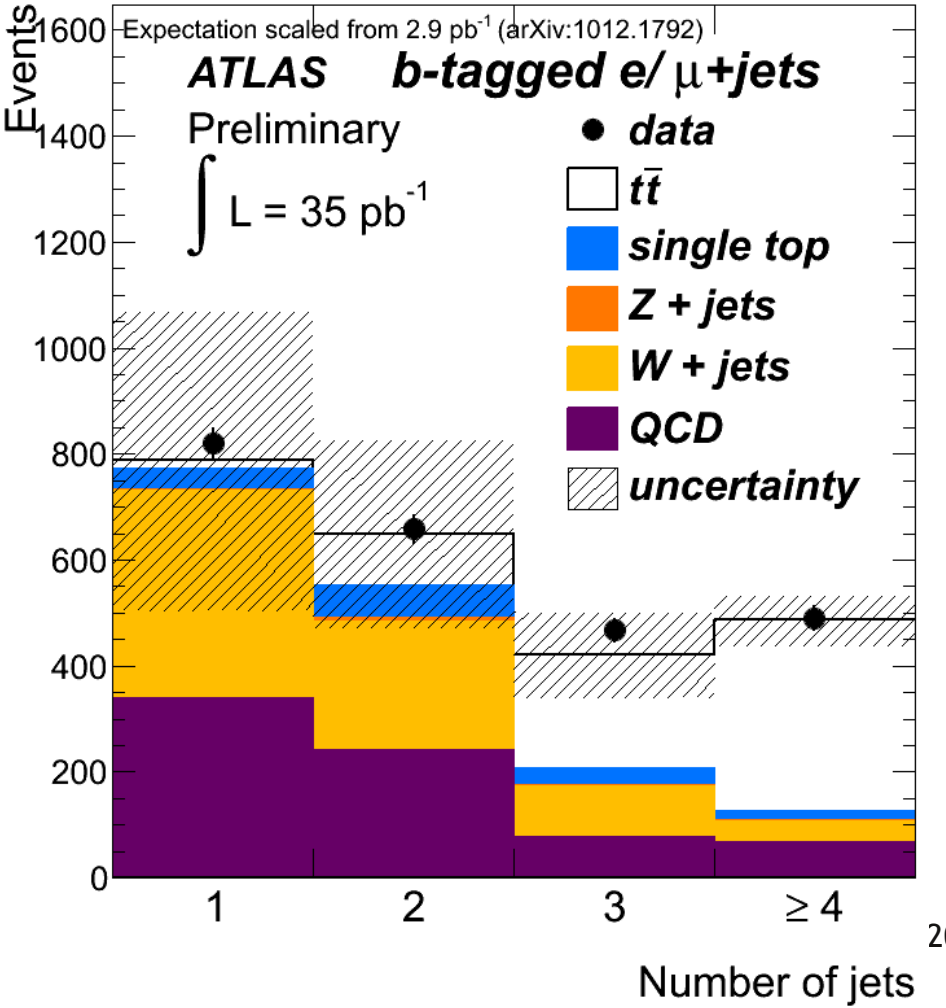
Single Lepton Channel

1 e or μ with p_T>20 GeV, E_T^{miss}>20 GeV, E_T^{miss}+m_T(W)>60 GeV

N_{jets} with p_T>25 GeV, with no b-tag requirement or at least one b-tag

Signal defined to have 4 or more jets, and at least 1 b-tag

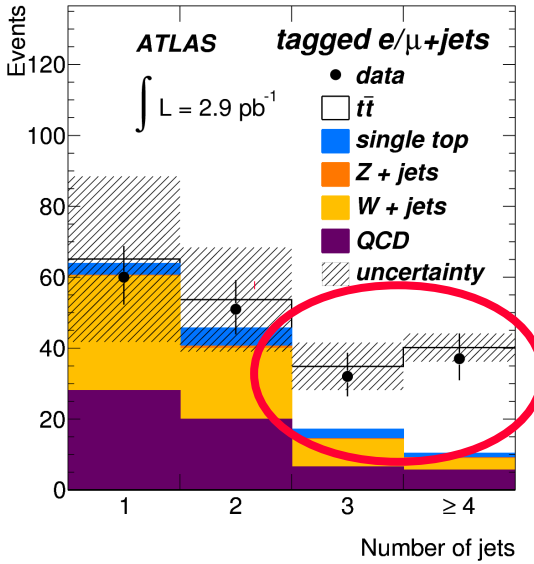


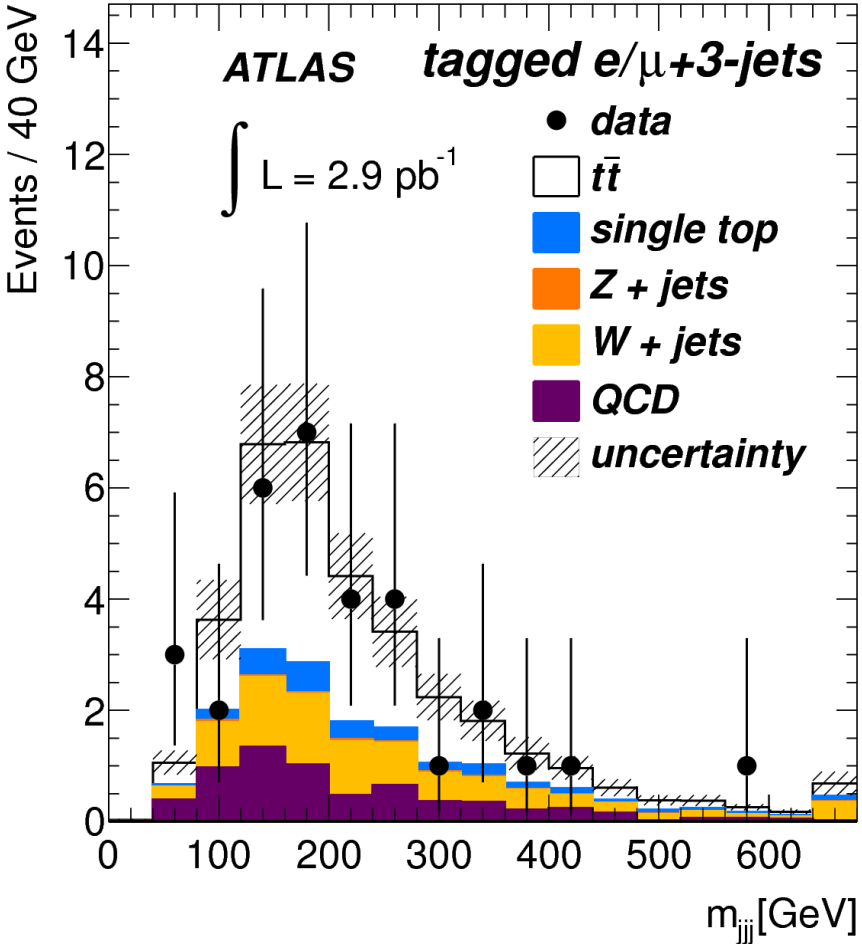


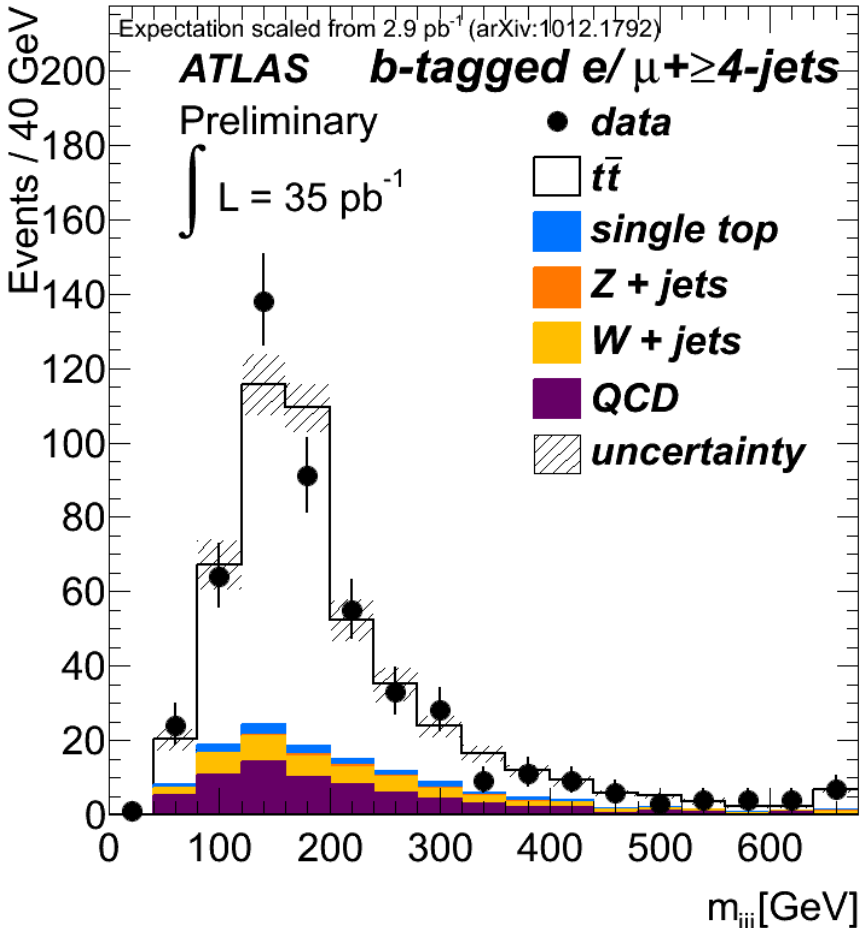
Cross-check: 3-jet mass

Invariant mass of the highest p_T 3-jet combination for tagged 3 and 4 jet events used in cross-check analyses

Agrees with top hypothesis







anuary 2011

Dilepton Channels

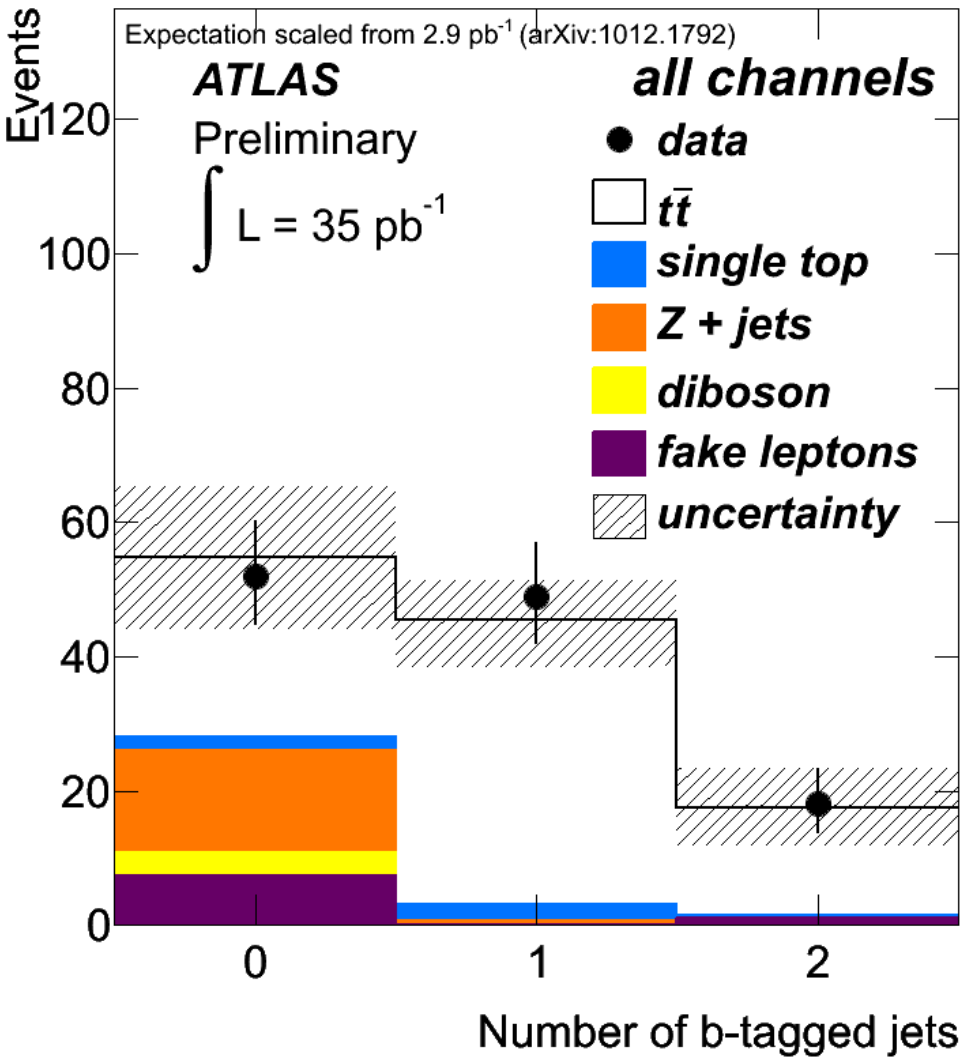
ee (μμ) channel:

- require E_T^{miss} >40 GeV (30) GeV
- veto m_Z region

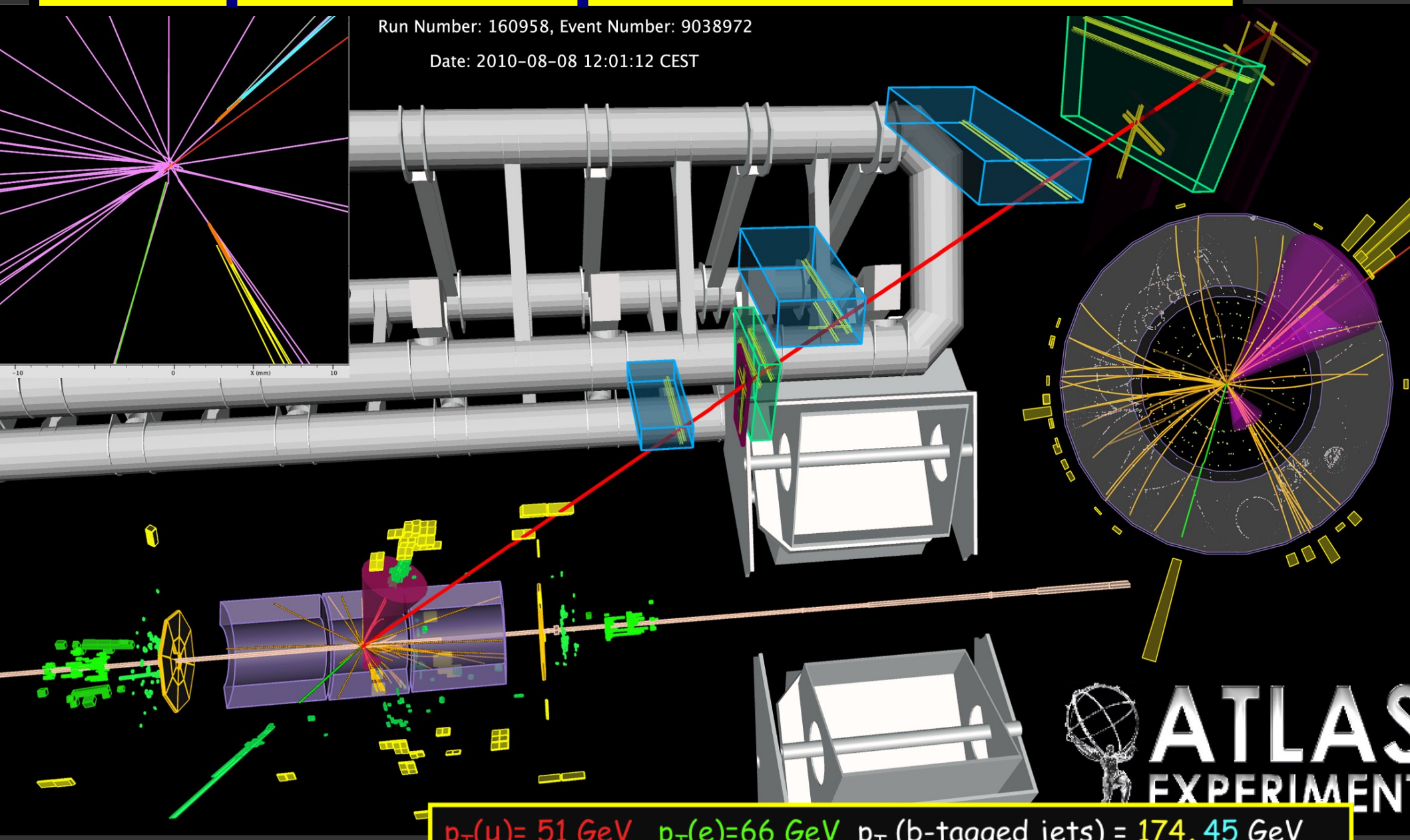
eμ: scalar sum of transverse energy H_T>150 GeV

Count events with two or more jets:
2 ee, 3 μμ, 4 eμ

b-tag is not used in the analysis, but is a cross-check



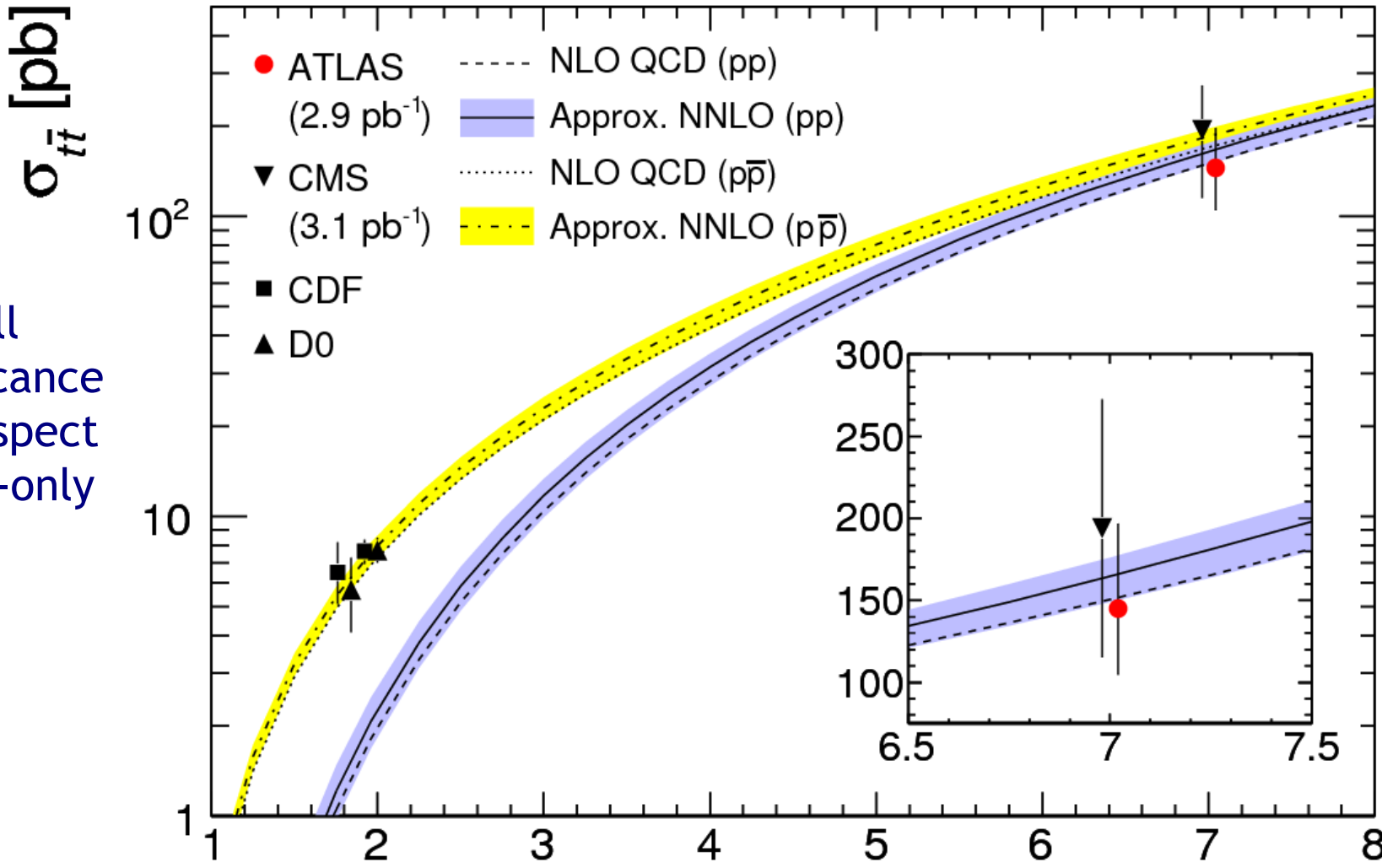
Dileptonic Top-Pair Candidate



$p_T(\mu)$= 51 GeV $p_T(e)$=66 GeV p_T (b-tagged jets) = 174, 45 GeV
E_T^{miss} = 113 GeV,
Secondary vertices: distance from primary vertex: 4mm, 3.9 mm
vertex mass : ~2 GeV, ~ 4 GeV

Top Pair Cross-Section

arXiv:1012.1792 (8 Dec 2010)



Combining all channels: significance of ~4.8σ with respect to a background-only hypothesis

$$\sigma_{t\bar{t}} = 145 \pm 31^{+42}_{-27}\ \text{pb}$$

In the full data sample recorded this year, ATLAS has ~ 700 top-antitop events i.e. ~ 1/8th of the sample of CDF or D0

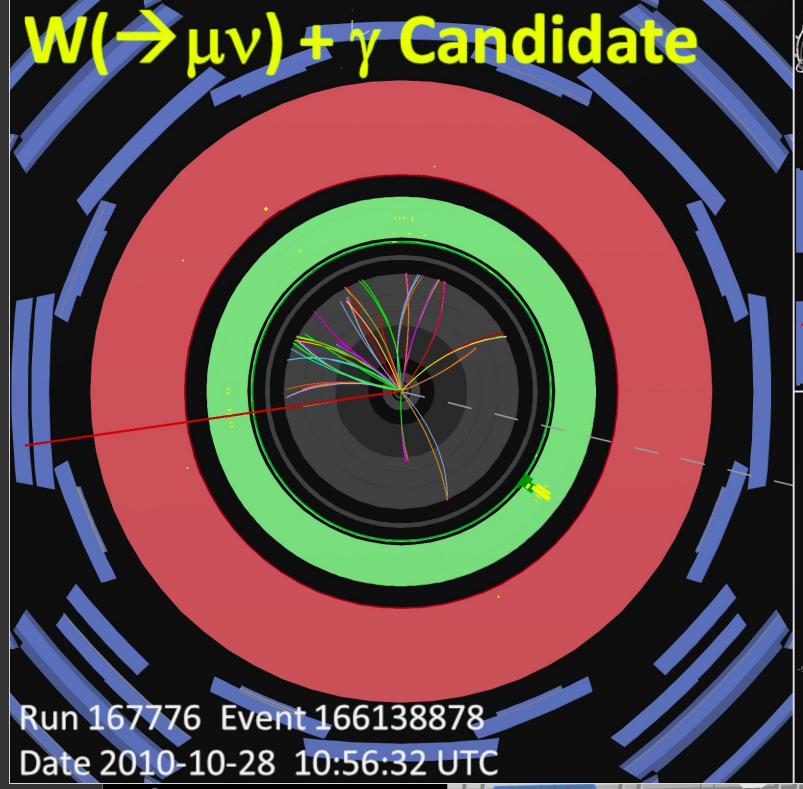
Dave Charlton, 26 January 2011

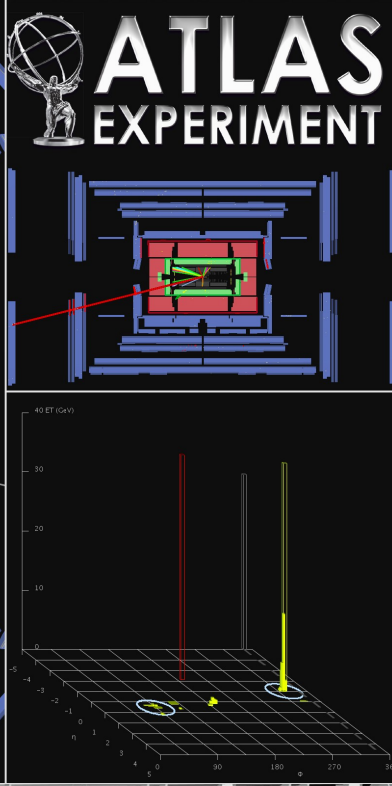
Dibosons

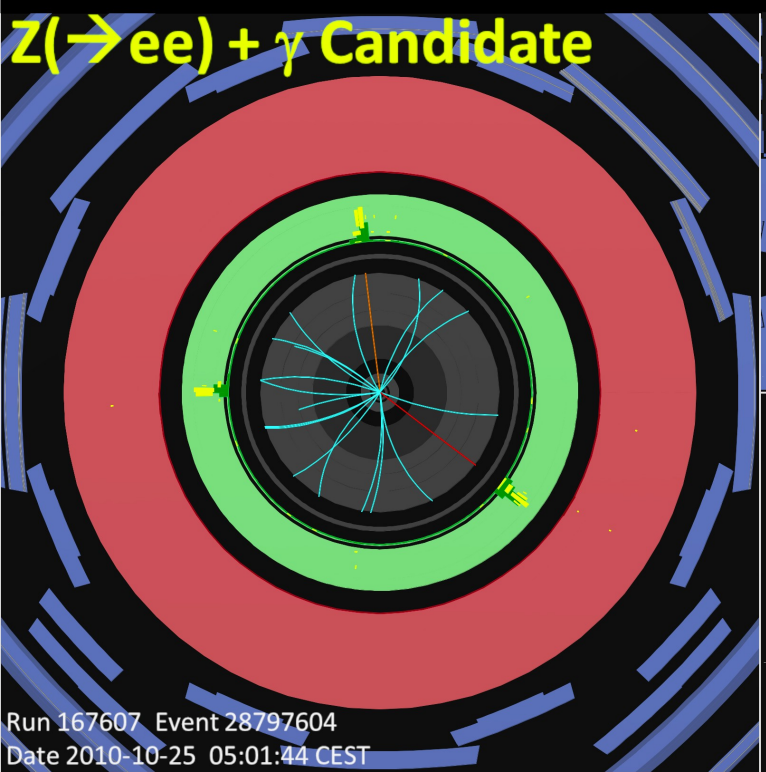
Electroweak diboson production is seen:
Wγ, Zγ, WW, WZ, ZZ...

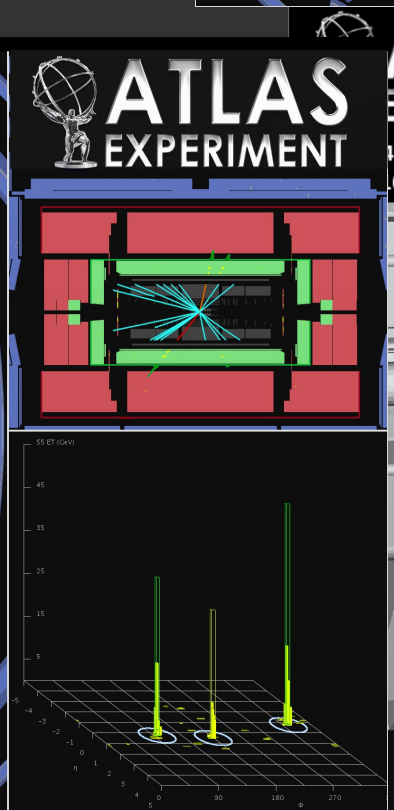
Key signatures close to new physics signal topologies

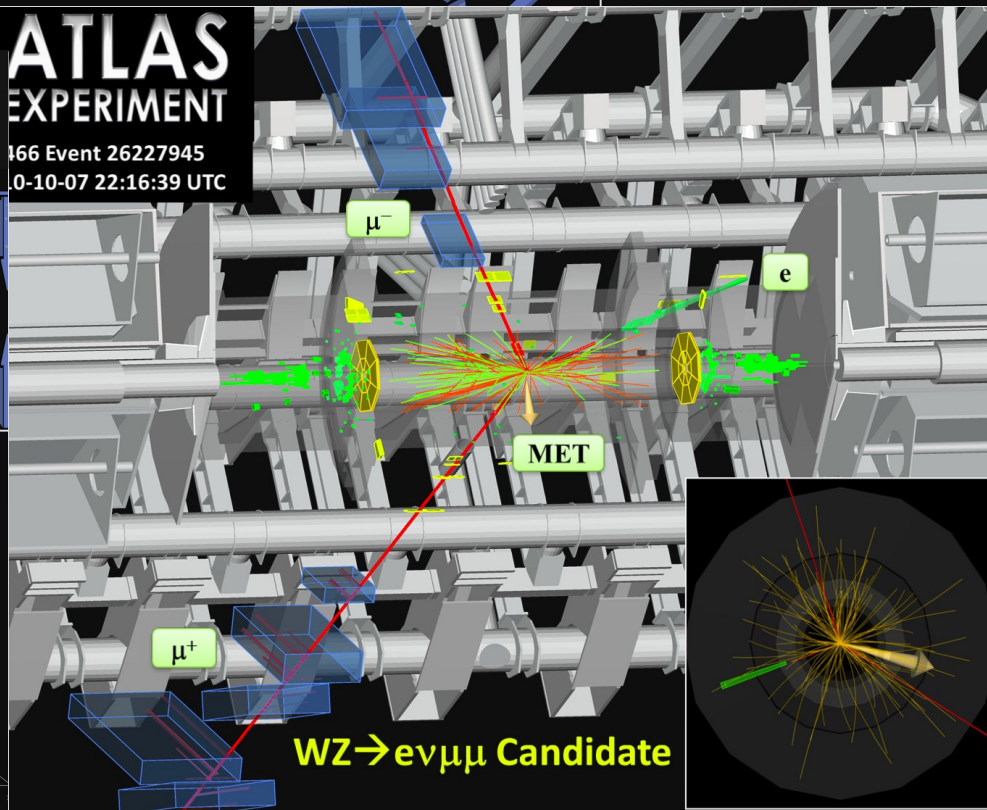
→ Song-Ming Wang talk





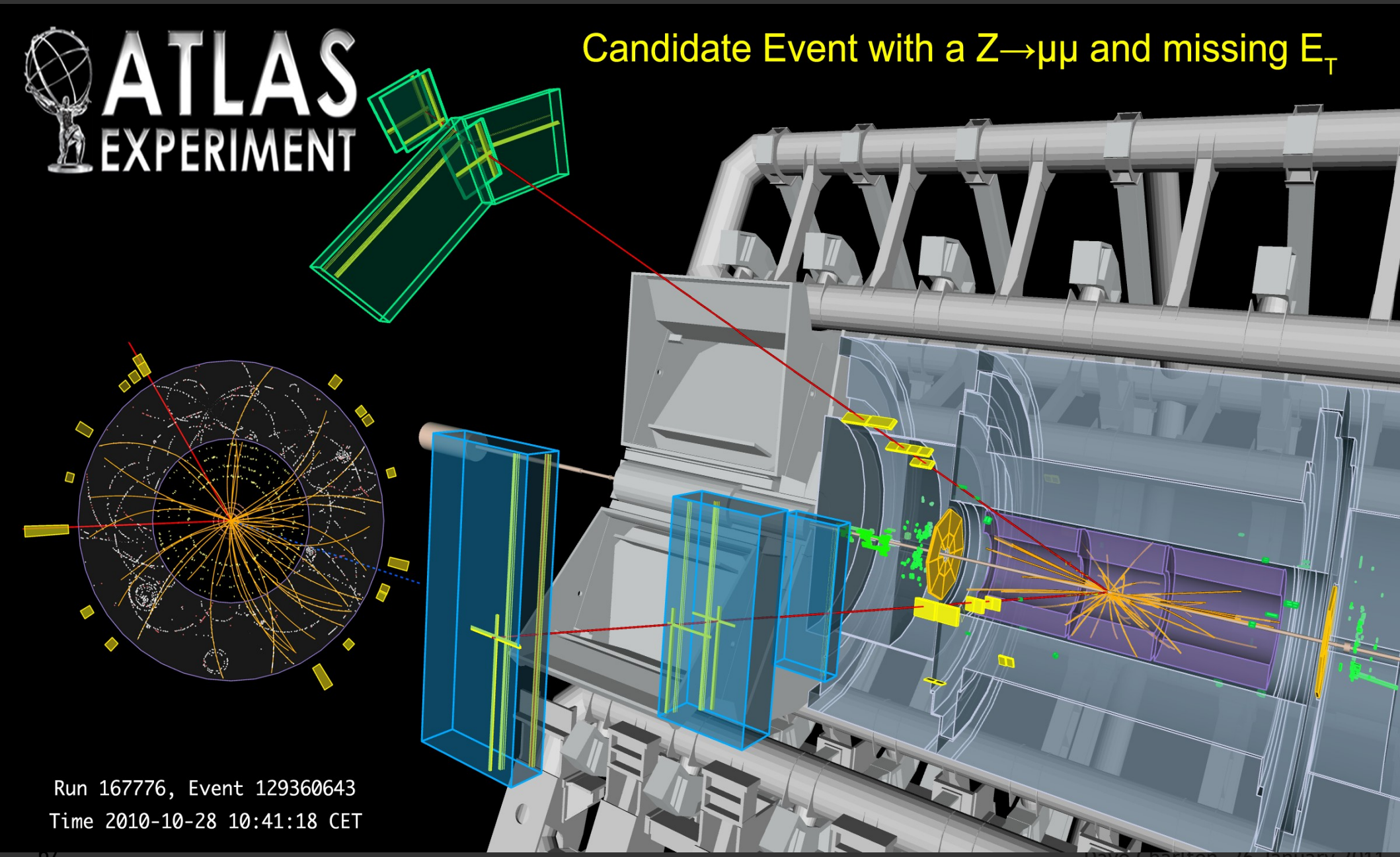




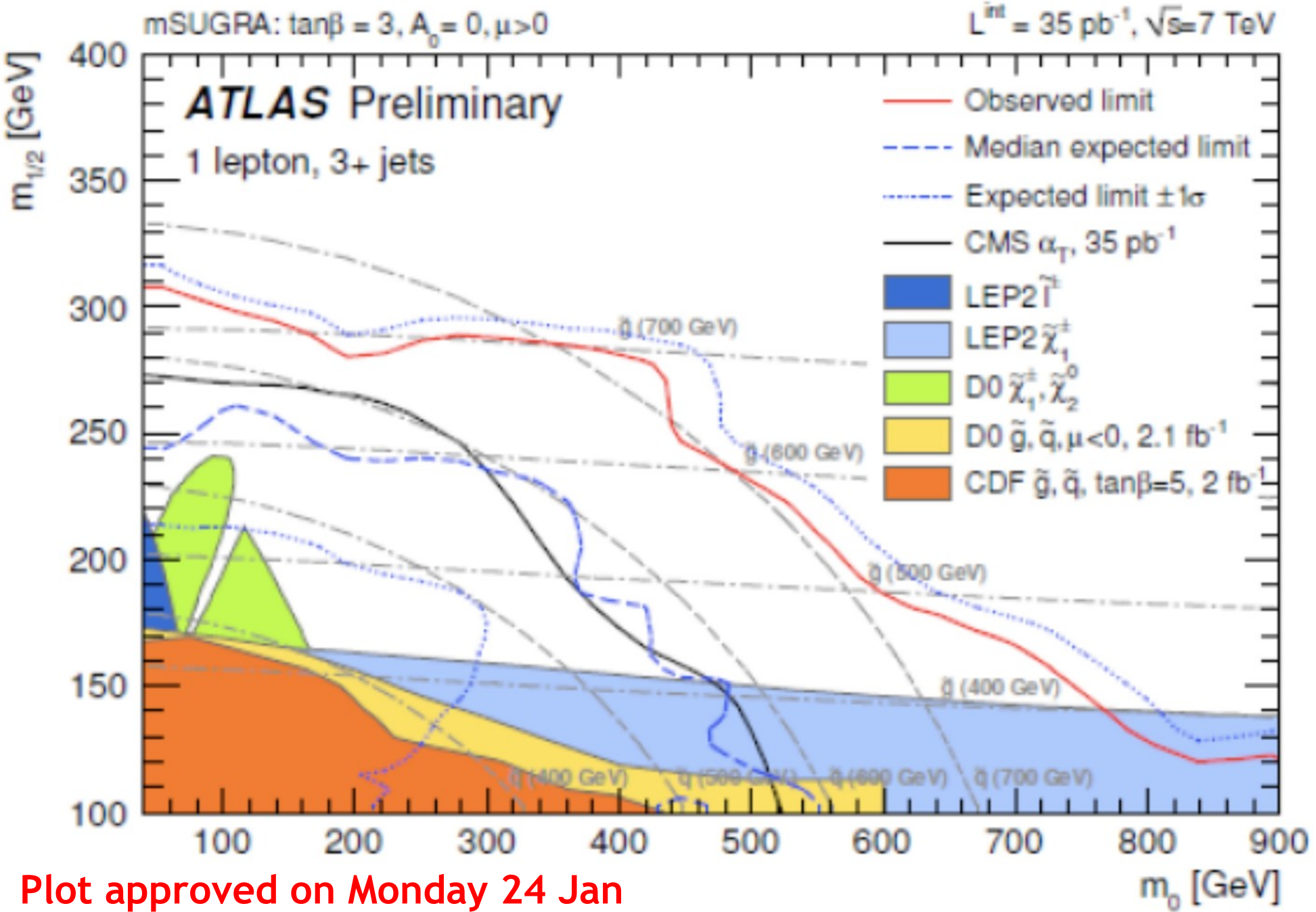


ZZ Candidate

$m_{\mu\mu}$ = 94 GeV, E_T^{miss} = 161 GeV



Much More Is Coming...



Plot approved on Monday 24 Jan

Prospects

LHC in 2011/12

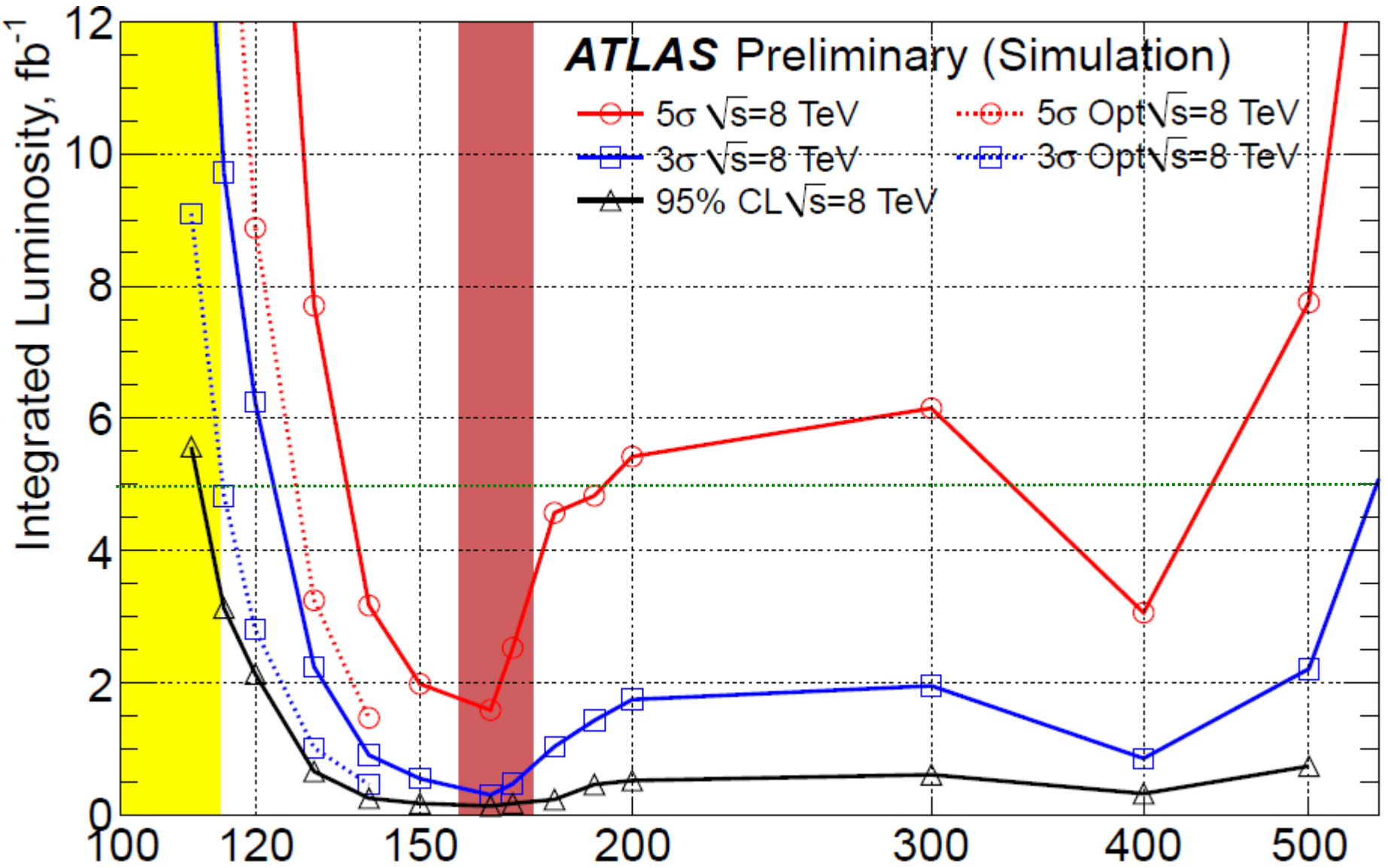
LHC workshop this week in Chamonix

- Discussing √s for 2011 – 7 or 8 TeV?
- Whether to continue run in 2012 before long (18m) shutdown which is needed to go to 14 TeV

It seems possible to have a luminosity of a few fb^{-1} at 8 TeV by the end of 2011

Albert De Roeck will show more on the exciting physics prospects (ATLAS – CMS sensitivities are generally quite similar)

Most interesting question: can we find the SM Higgs boson if it exists?



With optimised analyses and 5fb^{-1} at √s=8 TeV, each experiment expects to have 3σ sensitivity over 115<m_H<500 GeV

Summary

LHC commissioning and operation during 2010 was gradual and cautious, taking care to understand the collimation and safety systems fully

ATLAS detector, trigger, computing and data preparation systems are working even better than we expected!

The 2010 data have led to a rich harvest of physics results from ATLAS, with many more in production

Closely linked programme of measurements and searches going hand-in-hand – now more sensitive than the Tevatron in many channels

A goal of a few fb^{-1} at $\sqrt{s}$=8 TeV by the end of 2012 could allow us finally to solve the Standard Model Higgs puzzle

https://twiki.cern.ch/twiki/bin/view/AtlasPublic